

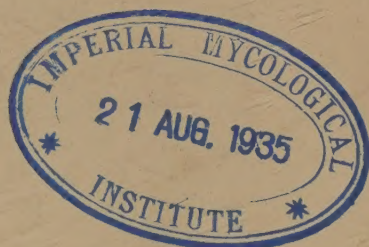
Agricultural Experiment Station

of the

UNIVERSITY OF KENTUCKY

FORTY-SEVENTH ANNUAL REPORT

For the Year 1934



Part I

Report of the Director

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* Died Nov. 24, 1934.

LETTER OF TRANSMITTAL

To His Excellency, Hon. Ruby Laffoon, Governor of Kentucky:

Sir: In accordance with an act of Congress, approved March 2, 1887, entitled, "An Act to establish Agricultural Experiment Stations, in connection with the Agricultural Colleges established in the several states under the provisions of an act approved July 2, 1862, and under the acts supplementary thereto," and of the act of the Legislature of the State of Kentucky, approved February 20, 1888, entitled, "An Act to accept the provisions of an act passed by the Congress of the United States, approved March 2, 1887, for the establishment and maintenance of Agricultural Experiment Stations in connection with Agricultural Colleges established by the several states and territories under an act of Congress approved July 2, 1862," I herewith submit the Forty-Seventh Annual Report of the Kentucky Agricultural Experiment Station.

Very respectfully,

THOMAS P. COOPER, *Director.*

January 1, 1935.

ANNUAL REPORT
of the
DIRECTOR OF THE KENTUCKY
AGRICULTURAL EXPERIMENT STATION
For the Year 1934

The work of the Experiment Station was much affected during the past year by the various emergency programs initiated by the National Government. So far as these programs concerned the agriculture of this state, they involved the resources and services of the staff of the College of Agriculture, whether of the Experiment Station, the Extension Division or the Teaching Division. At intervals, it was necessary to suspend the regular research work in markets and rural finance, agricultural economics, agronomy and soils, while the personnel in these departments devoted its attention to projects resulting from the emergency adjustment work. Such part of the research program as was unaffected by the emergency legislation was continued.

An agreement was made with the Tennessee Valley Authority to carry on a series of fertilizer experiments and tests in this state. This work was assigned to the department of agronomy and soils and organized in connection with the present soil fields and with certain research projects on soils previously in progress. It includes phosphate tests in crop rotation on 972 plots located at 11 different points in the state, representing practically all important soil areas outside the Bluegrass region; 10 tests on 130 plots at 8 different places in the state in top-dressing pasture with phosphates; 2 tests on 27 plots at 2

different points in the state in top-dressing alfalfa; and a test on 13 plots at Murray, using phosphates on tobacco. In addition, extensive greenhouse and laboratory studies are being made with TVA phosphates.

Much of this work confirms the investigations which have been carried on for a long period, but at the same time it opens a new field as to the best forms of phosphatic fertilizers that may be developed and used in the future. These investigations are of great importance to Kentucky, for the maintenance of a satisfactory permanent agriculture requires the use of phosphates in all parts of the state, except on the fertile soils of the Bluegrass region whose productivity is due to the natural supply of phosphorus.

Among other emergency projects undertaken by the Experiment Station in cooperation with the United States Department of Agriculture was the collection of preliminary material on farm mortgages and land values in the state. This resulted in the accumulation of a very large amount of informational material from every county in the state, basic to an understanding of questions of tax delinquency and tax laws. This study promises much information upon the ability of the various agricultural areas of the state to support the functions of county government. The data were gathered thru 452 agents assigned to every county in the state and they are now in process of compilation.

Detailed studies were made for the Federal Emergency Relief Administration, as to the various aspects of relief within the state. Many of these studies are fundamental to the development of a sound procedure toward the solution of the rural relief problems.

During the year, it was necessary to reassign and divert a part or all the time of six members of the staff for the emergency programs under the Agricultural Adjustment and other acts. Leave of absence was granted one member of the staff in farm economics to become land planning consultant in the state, for the National Resources Board. The constant cooperation of a committee from the Experiment Station has been

given to the question of land use. Thru the work which was carried on, the state will have before it detailed factual information upon the larger problem of land use.

The large amount of work undertaken this year has taxed the physical facilities of the Experiment Station. Office and laboratory space has been inadequate to care for the additional employees. Undoubtedly the Experiment Station will be called upon for increasing amounts of work in the important lines which are now being developed thru various types of national legislation. Provision must be made for buildings to afford the space necessary to carry on these important activities.

The work of the public service laboratories has so increased that these laboratories have outgrown the quarters assigned them. The demands made upon them are far in excess of what the funds appropriated by the legislature will permit. As the state and nation give more attention to the health of their citizens, the demands upon the laboratories become correspondingly heavy.

The varied activities of the Experiment Station for the year are presented briefly in this report. Results of work and detailed reports of research projects are issued from time to time in bulletins and circulars which are available upon request.

Seasonal Movement of Tobacco Prices. The study of the prices of burley tobacco was continued and data for the 1933-34 marketing season were analyzed. The general market average showed less seasonal variation than in any other recent year, with the possible exception of 1931. This may have been due to the nature of the crop, to the relation of preliminary forecasts of production to total actual marketings or to the effect of the trade agreement, between the Secretary of Agriculture and tobacco manufacturers, under which the crop was marketed.

Comparison of prices by grades indicated a general tendency for prices to rise thruout the season, a tendency which was indicated during the marketing season for the 1931 and 1927 crops also. All three crops were smaller than they were estimated to be at the opening of the marketing season. The tendency for prices to move upward during the 1931 crop mar-

keting season applied to grades of both high and low quality. The tendency of market averages to fall off despite the rising prices for specific grades, again bears out the importance of seasonal changes in the quality of tobacco marketed in determining general market averages.

Consumption of Tobacco. Estimates of the annual consumption of tobacco usually are based on a calculation of the disappearance during twelve-month periods ending either October 1 or July 1. To estimate the trend in consumption within shorter periods, an index of withdrawals of certain tobacco products was computed. From data on monthly tax-paid withdrawals of cigarettes and manufactured tobacco, for a number of years, indexes were computed, using the average withdrawals in each of the twelve months during the years, 1925 to 1929, inclusive, as 100. Assigning equal weights to cigarette withdrawals and to withdrawals of manufactured tobacco gives an index which parallels the disappearance of burley fairly well during the past ten or twelve years. More careful adjustments in the weights used, according to the relative importance of cigarettes and other types of tobacco products, doubtless would give a better indicator of the consumption of burley tobacco.

Factors Affecting the Price of Burley Tobacco. Further analysis was made of factors that affect the price of burley tobacco. Wide fluctuation in the general price level since 1912, when fairly complete data on tobacco first became readily available, necessitates the deflation or adjustment of original price data for the purpose of analysis. Even when this is done and a general upward trend in deflated prices is allowed for, the price of burley tobacco seems to have been on a lower plane during the period 1912 to 1920 than it has been since 1920.

The consumption of burley tobacco has passed thru two complete cycles since 1912. These cycles have had an upward trend with the high points of consumption in 1917 and 1927 and the low points in 1922 and 1932. Extreme surpluses in the supply of burley tobacco have developed in approximately ten-

year cycles generally opposite to the cycles of consumption. The total supply reached the high point during this upward trend in 1914, 1924 and again in 1933. The low point of supply occurred in 1908 and at the time of the "cut-out" in 1917 and again in 1928.

An analysis of annual carry-over on October 1 of each year was made by adding to published stocks reports for that date, an estimated figure to cover losses in stemming and redrying. When storage stocks, so calculated, were expressed as a ratio of annual consumption, it was found that a carry-over in storage about 15 percent larger than annual consumption might have been considered normal in 1912, when a carry-over now of about twice our annual consumption must be considered about normal.

Nicotine Content of Tobacco. A study of the nicotine content of dark tobacco grown on the Experiment Station farm during the past season was made to ascertain the stage of growth at which the maximum nicotine content occurs in different parts of the dark tobacco plant. The results show a gradual increase in the nicotine content of the leaves as they develop. The maximum percentage of nicotine was found at the time of cutting. However, the plants grown on the Experiment Station farm in 1934 did not contain as much nicotine at the time of cutting as other samples of dark tobacco grown in some parts of Western Kentucky in 1933. This indicates that the nicotine content of tobacco probably is affected by such factors as character of soil, fertilizers, sunshine, temperature and moisture. The maximum nicotine content of any sample of dark tobacco thus far analyzed was approximately 6.5 percent and the average for a considerable number of samples was 4.5 percent.

A low-nicotine variety of tobacco (Bauer) grown the past season on the Experiment Station farm, contained less than one-tenth of one percent of nicotine in the dry leaves. Two samples of tobacco leaves were received that contained approximately one-tenth of one percent of nicotine in the dry condi-

tion. The samples were apparently of normal size and very similar in appearance to normal dark and burley tobaccos, tho the nicotine content was much lower than in any samples of these tobaccos previously analyzed. The samples of low-nicotine tobaccos afford direct evidence that it is possible to produce a variety of tobacco practically free from nicotine. Such a variety of tobacco might have important commercial possibilities. Another variety of tobacco (*Rustica*) has been grown in other parts of this country and the nicotine content found to be as high as 13 percent. When this variety was grown on the Experiment Station farm this year, only short, stubby, abnormal plants were produced and the leaves contained about 4.5 percent nicotine, less than half the amount found in this variety of tobacco grown elsewhere.

Hot Water Treatment of Tobacco Seed. It was found that tobacco seed may be treated safely in hot water at 52° C for 20 minutes following a presoaking of 1 hour. Seeds are not injured when treated 3 hours at 48° C, 1¾ hours at 50° C; 45 minutes at 52° C, 30 minutes at 54° C, 20 minutes at 56° C and 15 minutes at 57° C. An exposure of 20 minutes at 52° C is sufficient to destroy *Bact. angulatum* and *Bact. tabacum* in dried leafspots.

Control of Wireworm Injury to Tobacco Plants. The practice of planting tobacco after sod, generally results in considerable injury by wireworms. Examination of tobacco plants in the spring of 1934, shortly after they had been transplanted, showed 25 percent injured in one field and 18 percent in another. The injured plants could be distinguished easily because of their wilted condition. In one row of 95 plants, 49 were found to be injured.

The number of wireworms in each soil was estimated from the average of three counts, made by screening the soil from areas of 4 square feet to the depth of 8 inches. Counts from old sod that had been pastured for several years indicated 47,715 adults and 24,539 larvae per acre, while old sod that had not been pastured had 217,800 adults and 43,560 larvae. This in-

dicates that pasturing had a decided effect in diminishing the number of wireworms in sod land. Wireworms in a tobacco plot the first year after sod numbered 3,630 adults and 79,860 larvae, per acre. An adjoining plot, part of the same land, but which had been in tobacco three seasons, contained 7,260 adults and 3,630 larvae, per acre, a great reduction in the number of larvae. These counts were made in September and the first week in October.

Adults, collected in the fall of 1934, were of two species of small wireworms, *Drasterius elegans*, and *Monocrepidius auritus*; of these, 92 percent were *M. auritus*. Larvae of two other species were found.

Tobacco Mosaic. In tobacco grown on a commercial scale, on the Station farm, mosaic was again controlled by preventing direct infection from the hands of the workers during pulling and setting. The few plants in which mosaic developed within three weeks after setting (.07 percent) were removed. The types of mosaic which developed after this time (1.22 percent), which could only have been transmitted from perennial weeds, were given some attention. Twenty-seven strains, each different in symptom expression, were recognized.

The Etch virus disease and cucumber mosaic were unusually abundant in tobacco the past season while ringspot was scarce. In tobacco set on three sides of a field of both early and late crop Irish Cobbler potatoes, infection with the vein-banding virus varied from 86 percent in the plots close to the potatoes, to 2 percent in the parts of the plantings most distant from the potatoes.

Soil carryover of mosaic was again studied in plots where the previous year there was, respectively, no mosaic, 100 percent yellow mosaic, and 100 percent green mosaic. There was no evidence of soil carryover, up to blooming time. Where cut-up stalks were returned and disked in just before setting, 3 percent yellow mosaic developed during the summer where yellow mosaic stalks had been returned; slightly over 6 percent green mosaic where green mosaic stalks had been returned;

and 1 percent green mosaic where no stalks had been returned. The field had been in tobacco the previous year.

It was clearly demonstrated both in the greenhouse and in the field that only certain strains of tobacco mosaic cause burning, while other strains cause only mottling with no death of leaf tissue whatever. The "burning" strains tested produced necrotic or burned areas on the parts of the leaves inoculated.

Mosaic-Resistant Tobacco. Seed of a mosaic-resistant tobacco was received from J. A. B. Nolla, Puerto Rico, who collected it in Colombia, S. A. Over 30 strains of tobacco mosaic have been transferred to this variety. Most of them produced no visible effect. Several strains produced a necrotic spot or a necrotic ring around the point of entrance of the virus and failed to become systemic. A few strains produced ringspot-like chlorotic to necrotic patterns on the leaves as they were slowly invaded. All the strains which failed to cause necrosis on the inoculated leaves became systemic but the virus did not enter the growing point. Hybrids between burley tobacco and the mosaic-resistant Ambalema are being grown in an attempt to develop a desirable mosaic-resistant white burley variety.

Sore-Shin and Frogeye of Tobacco. Sore-shin of dark tobacco caused by *Sclerotium bataticola* was found near Murray, Ky. It killed many plants in a field during and following a hot period. This is believed to be the first report of this disease.

Frogeye of burley tobacco was severe for the first time in 15 years thruout much of the burley section of Kentucky. It caused not only the usual frogeye spots, but late infection resulted in numerous green spots, about 1/4 inch in diameter, on the upper leaves of cured tobacco.

Angular Leaf-Spot and Wildfire. A study of the organisms causing these diseases showed that numerous fairly stable strains of both organisms exist in nature, differing in the types of colonies produced on agar. Colonies vary from smooth watery thru many types of rough, wrinkled, and degrees of

opaqueness. Several of these were passed thru 10 consecutive tobacco leaves, were pathogenic, and were recovered without change in colony type. Both organisms died in 5 or more days, on ordinary potato agar with 2 percent dextrose, because of increasing acidity as growth progresses. Potato agar alone increased in alkalinity, but 1/2 percent dextrose in potato agar was found to be satisfactory for growth and storage of the organisms. Beef extract broth also, was satisfactory.

Rootrot-Resistant Tobacco. A very promising new variety of rootrot-resistant white burley tobacco has been developed by hybridization. It is designated "Kentucky No. 16." It will be tested by growers in 1935. It is a larger-growing variety than No. 5, producing an average of 2 to 3 more leaves per plant than any of the common varieties. Quality appears to be excellent. So far it has produced exceptionally vigorous plants, the stand the past spring being practically perfect while other varieties had numerous misses due to drought at and following setting. Progress is being made in the development of black-root-resistant strains of dark-fired tobacco, several highly resistant strains of fair quality having been developed. Satisfactory strains of air-cured dark tobacco resistant to root-rot have been developed and tested in Daviess County for the past few years.

Sulfur Deficiency of Tobacco. A previously unobserved deficiency disease of tobacco was found in Owen and neighboring counties in the fall of 1934, which appeared to be due to insufficient sulfur. The tips of the upper leaves were yellow and when cured were much lighter in color than the remainder of the leaf.

Topping and Suckering White Burley Tobacco. During the five years that this experiment has been in progress, only in 1929 has the yield or quality been affected greatly by the method of handling. In that year there was sufficient moisture to keep the tobacco growing until fully matured, and that topped early and suckered frequently yielded about 35 percent more and was worth 20 percent less per pound than that treat-

ed in other ways. Allowing plants to go without topping and suckering gave a very low yield with poor quality in the leaf but good quality in the flyings, trash and lugs. This method gave such unsatisfactory results that it was continued only two years. In 1930, 1931, 1932 and 1933, dry weather necessitated cutting the crop soon after topping and before fully matured. This resulted in much uniformity both in yield and quality under all methods tried. The 1934 crop figures are not available.

Fertilizer Tests with Tobacco. The effect of different ratios of nitrogen to potash in the fertilizer, different carriers of nitrogen and different quantities has been studied in recent years. It is rather remarkable how little apparent effect upon the appearance of the tobacco is produced by the fertilizers. Neither in 1933 nor 1934 could the fertilized plots be distinguished from the unfertilized at any stage of growth, even in unmanured land where tobacco has been grown frequently in the rotation. Yields from the 1934 test are not available yet, but following are the increases in yield and value for the various fertilizer treatments in 1933 as compared with adjoining check plots:

Plot	Fertilizer		Sources of Nitrogen	Increased Yield Per Acre, Lbs.	Increased Value
	Lbs. per A.	Formula			
1	500	4-8-4	Nitrate of soda	75.0	\$11.50
2	500	4-8-4	Sulfate of ammonia	30.0	5.90
3	500	4-8-8	Nitrate of soda	130.0	33.50
4	500	4-8-12	Nitrate of soda	—52.5	—9.80
5	500	8-8-4	Nitrate of soda	92.5	11.40
6	500	12-8-4	Nitrate of soda	60.0	8.10
7	1000	4-8-4	Nitrate of soda	140.0	24.10
8	1000	4-8-4	{ Nitrate of soda ⅓ Sulfate of ammonia ⅓ Cottonseed meal ⅓ }	145.0	25.30
9	1000	8-8-12			

Half the potash was from muriate and half from sulfate, except in No. 8, where two-thirds of the potash was from sulfate.

Rotation Experiments with Tobacco. The results of the rotation experiments carried on for 18 years, may be summarized briefly as follows:

1. The (1) tobacco, (2) wheat, (3) orchard-grass and clover, and (4) orchard-grass rotation produced very good yields of fair quality leaf if manure or fertilizers were used on the tobacco. While fertilizers were practically as effective as manure during most of the period of this experiment, for the last few years, the manure gave decidedly better results particularly as regards yield. Where neither fertilizer nor manure was used, yield steadily decreased and the quality of the leaf was far below that of manured or fertilized plots.

2. In the 4-year rotation of (1) tobacco, wheat, corn and clover, manure was used on the corn and in recent years fertilizer on the tobacco. A high productivity of the soil was maintained, as shown by the yield of all crops, but the average quality of the tobacco was not quite so good as in the rotation first mentioned. In recent years, however, the quality improved greatly.

3. Another 4-year rotation is like No. 2 except that alfalfa is used instead of clover. Manure was used on the corn, and the tobacco, in recent years, was fertilized. In order to produce alfalfa, liming was necessary. Lime was not used during the last two rounds of the rotation. The yield of tobacco in this rotation was good but the quality poor. Whether the poor quality can be attributed to the preceding crop of alfalfa or to the use of lime was not determined. The fact that quality has constantly improved since the use of lime was discontinued would indicate that lime was a more important factor in causing poor quality than the preceding crop.

Various changes have been made in the 3-year rotations since the project was started. For the last few years the chief effort in these rotations has been to determine the relative value

of orchard-grass, red clover and Korean lespedeza crops to precede tobacco in short rotations. All the tobacco is fertilized but no manure is used in any of the rotations. Up to the present clover has given the best quality and yield and orchard-grass has been slightly better than lespedeza.

Types of Farming and Their Distribution. The study gives a general view of the kinds of farming practiced in different parts of the state, as related to local conditions. It defines the extent and distribution of areas in which certain types of farming predominate, and the reasons for this. The state was divided into eight great areas, differentiated largely by topography, character of soil and kind of agriculture, namely: Mountain, subsistence farming; Eastern Pennyroyal and Knobs, general farming; Bluegrass, livestock-white burley tobacco farming; Pennyroyal Plain, dark tobacco-livestock farming; Western Coal Field, subsistence-dark tobacco farming; Lower Ohio Valley, corn-livestock-dark tobacco farming; The Purchase, dark tobacco-general farming; Suburban areas, dairying, truck farming, etc. Twenty-three subclasses were recognized. The results of this comparative study may suggest beneficial adjustments in our systems of farming.

Part-Time Farming. Some significant instances of the successful combination of work on and off the home tract were observed among a group of 433 families engaged in part-time farming. Of these, 100 were located near Louisville, 86 near Corbin and Barbourville, 43 near Richmond, and 204 near Lexington. Of the Lexington group, 100 families were white and 104 colored. The colored families in the Lexington area living on subsistence acreages relied chiefly on day labor in Lexington or on nearby farms. The white part-time farmers in all the areas were engaged chiefly in various types of urban employment. Very few of them were agricultural laborers.

The Richmond area is typical of that surrounding many rural county-seat towns. Here the opportunities for non-farming employment are much more limited than near the larger cities like Louisville. The part-time farmers in the Richmond

area obtained more of their total income from their farm tracts than did those in the other areas. Part-time farming in this type of area offers a good opportunity for the family which has a pension, old-age savings, or other forms of savings and for the small number of men who are able to get seasonal work at carpentering or other of the skilled trades.

In the Corbin-Barbourville area and in part of the Louisville area, lack of land of adequate fertility and productiveness was found to limit sharply the opportunities for increasing the number of part-time farmers. The chief obstacle in the way of the expansion of part-time farming in this state is the limitation of industrial and other urban employment in most areas in Kentucky.

Prices of Kentucky Farm Products. Work upon an index of farm prices was continued. Original warehouse reports of sales of each type of tobacco, of the crops of 1931, 1932 and 1933, were copied, edited and tabulated. Progress is being made in the analyses of the data for other crops.

Farm Taxes and County Government. The study of farm real-estate taxes was completed. It shows that, compared with other states, the increase in farm real-estate taxes in Kentucky since 1913 was about average. Furthermore, the increase was altogether in the local taxes. Certain findings suggest that maladjustments in assessments between counties may be a major factor in the farm tax problem.

The study of farm taxes and local government in Livingston and Crittenden counties was completed. It shows that the traditional conservatism ascribed to rural people generally is a dominating force in the conduct of local government in the rural districts of the state. Some of the conclusions are: (1) Altho, in the opinion of farmers, high taxes constitute the major problems of local government, a careful analysis of pertinent tax data failed to show that farm land was being taxed at exorbitant rates. Farmers in these counties suffer more from meager natural resources and low incomes than from tax rates which are excessively high in relation to land values.

(2) A difficult financial situation has developed in both counties because of the issuance for several years past of county warrants and claims in excess of current tax revenues. (3) Certain changes in operation and organization would permit some reduction in governmental costs without impairing essential services. However, substantial reductions in costs, without serious impairment of essential services, must await changes in state laws. (4) Consolidation of Livingston and Crittenden into one county appears impractical at present, as a means of effecting substantial reductions in the cost of county government. (5) School costs probably could be reduced somewhat in each county by certain changes in administrative practices and consolidation of selected districts.

Preliminary analysis of the tax records of every county in the State indicates that farm tax delinquency was greatest in regions of poor soil and rough topography; that negro farmers did not pay taxes as promptly as white farmers; that the smaller farms were more often delinquent than the larger ones; that farm tax delinquency was much greater in 1933 than in 1928; and that the assessed value of farm land is much lower than sales value as reflected in the selling prices of farm land, but that since 1931 the margin between assessed and sales value of farm land has narrowed.

Iodine Researches. Analysis of forty samples of corn (grain) grown at different places in the Eastern Coal Field area in Kentucky showed wide differences in iodine content. The maximum was 200,000 ppb,* and the minimum 60 ppb. Presumably the corn containing the most iodine was grown with the use of some fertilizer containing iodine, because the average of the analyses made heretofore of corn that was known to have been grown without fertilizer is about 100 ppb. The average iodine content of 18 samples of wheat analyzed was about 400 ppb.

During the growing season, graded doses of potassium iodide were added to soil on which corn was growing. Analyses

* Parts per billion. That is, parts in 1,000,000,000.

of the blades and stalks were made several times during the growing season and of the grain after maturity. The grain produced on the soil that received the maximum dosage of potassium iodide contained 3,000 ppb of iodine. The iodine content of the corn was in proportion to the quantity of potassium iodide applied.

The iodine content of cod and halibut liver oils was determined. The average was approximately 3,000 ppb. The largest amount of iodine was found in the refined medicinal cod liver oil.

Arsenic Content of Soil and of Plant and Animal Tissues. A new method for the determination of arsenic in soil was worked out and the arsenic content of 47 samples of soil was determined by the method. The minimum arsenic content in any sample was 0.00011 percent, the maximum, 0.0015 percent, and the average of all samples was 0.0008 percent. It is therefore evident from the 47 samples of different kinds of soil analyzed that arsenic is a normal but a variable constituent of soils.

The arsenic content of bluegrass, orchard grass and red clover had the following range: Maximum 0.000094 percent, minimum 0.000009 percent, average of six samples 0.000044 percent. Corn grains contained, maximum 0.000114 percent, minimum 0.000007 percent, and the average of 19 samples was 0.000042 percent. Wheat contained, maximum 0.00016 percent, minimum 0.000012 percent, and the average of 18 samples was 0.000054 percent of arsenic.

Feeding experiments were carried on with rats during the year to ascertain the limit of toxicity and the lethal doses of lead arsenate and arsenic trioxide, respectively. When different amounts of As_2O_3 were fed in a normal grain ration, 0.020 gram was fatal in 1.5 hours to a rat weighing 35 grams, and 0.0315 gram of As_2O_3 was fatal in 48 hours to a rat weighing 105 grams, whereas 0.020 gram of lead arsenate was fatal to a rat weighing 40 grams in 24 hours, and 0.0463 gram of this compound was not fatal to a rat weighing 185 grams. Apparently, young rats are more sensitive to arsenic poisoning than mature rats.

The analyses of the various organs of rats which were fed small doses of arsenic for a period of time showed that the blood contained the maximum amount. Other organs in descending order of arsenic content were: spleen, heart, liver, kidneys, hair, stomach, muscle and brain.

Plant Tests to Determine Soil Deficiency. The proportions of soluble nitrogen and phosphate phosphorus were estimated in the lower conducting tissues of certain plants to determine if such tests can be used to indicate soil deficiencies. With tomatoes the partial correlation coefficients between yield and the concentrations of N and P in the plants were as high as 0.824 for yield and phosphate phosphorus and 0.751 for yield and soluble nitrogen, when the tests were made during the early stages of growth. Tests during the fruit-setting stage gave a correlation for soluble nitrogen of 0.062 while that for phosphate phosphorus was 0.724. Tests with lettuce, cucumbers, sweet corn and lima beans also showed positive correlations. The work has not been concluded.

Determination of Total Nitrogen in Soil and Plants. The method depends on oxidation of the nitrogen to nitric acid by the use of sodium chlorate and sulfuric acid, and determination of the nitric acid by the phenoldisulfonic acid method. By dispensing with distillation the procedure is greatly simplified and shortened. Five-tenths to one gram of soil is oxidized with sodium chlorate and sulfuric acid and placed in a hot water bath for about 5 minutes. The solution is then neutralized with sodium hydroxide and filtered. Fuming sulfuric acid is added to an aliquot of the filtrate to complete the oxidation and decompose excess chloric acid. As soon as the excess chlorine is shaken and blown out, phenoldisulfonic acid is added and the yellow color developed in the usual way. There is no loss from the presence of hydrochloric acid provided heavy metals are removed by the precipitation by sodium hydroxide and filtration. With plant tissue the heavy metals were not present in amounts that would require their removal, but oxidation with chlorate required the use of a 200 cc Erlenmeyer flask attached

to a reflex condenser. After about 5 minutes of heating the oxidation was complete; phenoldisulfonic acid was added directly to an aliquot of the oxidized solution of plant material and the yellow color developed in the usual manner.

A Test for Soluble Nitrogen in Plant Tissue. Recently workers in several states have shown that plants assimilate more nitrogen as compounds other than nitrate, than was formerly supposed. At the Kentucky station it was found that lima beans made a luxuriant growth with no nitrate in the tissues. Determination of the soluble nitrogen showed that the plants were assimilating nitrogen in forms other than nitrate. Tests with other plants seem to indicate that the determination of soluble nitrogen in the tissues is a better index of the nitrogen available to the plant than the determination of nitrate. A 2-percent acetic acid extract of the lower conducting tissues of the plant is made. A small aliquot of this extract is placed in a test tube, then a granule of sodium chlorate, and a volume of fuming sulfuric acid (15% SO_3) equal to thrice that of the aliquot is added. Liberated chlorine is blown out and the same amount of phenoldisulfonic acid as of extract used is added to the solution. It is then diluted with water and neutralized with sodium hydroxide. The nitrogen present is determined by the usual colorimetric procedure. This procedure is suitable for field tests because it is short and simple and no heat or complicated equipment are required.

Nitrogen Fixation in Percolating Water. An experiment on the fixation and accumulation of nitrogen in soil in which bluegrass is grown in association with certain legumes has been in progress since October 3, 1933. At the beginning of the experiment, all the lysimeters were seeded to wheat except two which were kept bare. From October 3, 1933, to March 31, 1934, the average amount of nitrogen in the drainage from the two bare lysimeters was equivalent to 29.43 pounds per acre and from the lysimeters planted to wheat 5.94 pounds per acre. The average total inches of drainage from the lysimeters during this period was 7.66. The total rainfall during the period was 16.88 inches.

Availability of Phosphates. In cooperation with the Tennessee Valley Authority, nine series of field tests were started this spring, at Berea, Campbellsville, Greenville, Hopkinsville, Princeton (two), Mayfield, Lone Oak and Murray, to compare the effectiveness of ordinary superphosphate, treble superphosphate and manufactured dicalcium phosphate and tricalcium phosphate on soil of different types, limed and unlimed. Muriate of potash and nitrate of soda were applied to all plots, including the no-phosphate plots. The tests were made on land of low productivity that had never been limed or fertilized, so far as could be determined. The average increase in yields of all tests are shown in the table.

	Sheaf Oats, Lbs.		Corn, Bushels	
	Limed	Unlimed	Limed	Unlimed
Average yield of check plots	1212	1251	18.7	18.4
Increase for superphosphate	458	516	4.2	3.3
Increase for treble superphosphate	385	427	5.1	3.3
Increase for dicalcium phosphate	331	394	3.4	3.4
Increase for tricalcium phosphate	137	262	1.7	1.7

In this connection, a pot experiment of 228 pots was started, using Turkish tobacco and two different soils. Marked differences were evident in the effect of the different phosphates on the growth of the plants.

Residual Effects of Superphosphate and Rock Phosphate. In 1930, certain plots on the Berea, Greenville and Mayfield soil experiment fields, some of which had been fertilized regularly with superphosphate since 1913 and some of which had been regularly fertilized with rock phosphate were divided. On one-half of the plot the use of phosphate was continued and on the other half its use was discontinued. Superphosphate had been used at the average rate of 160 pounds per acre per year and rock phosphate at twice this rate. The rotation on these fields was corn, wheat, and two years of mixed legume and grass hay (rye at Berea). On the three fields there are six com-

parisons of superphosphate omitted and superphosphate continued, and six similar comparisons for rock phosphate. Following are the average yields for these tests:

	Superphosphate		Rock Phosphate	
	Used	Not Used	Used	Not Used
Corn, Bus. Average 8 crops	53.9	53.0	56.2	56.5
Wheat, Bus. Average 8 crops	21.3	20.2	21.5	21.5
First Year, Hay, Lbs.				
Average 3 yrs.	4143	3845	4456	4413
Second Year, Hay, Lbs.				
Average 2 yrs.	5008	4811	4983	4845

In the first-year hay crop there were 16 cuttings on the three fields; for the second-year hay, there were 11 cuttings. There was no large difference on any of the fields for the crops on the two halves of the plots. These tests show the very great value of the residue phosphorus left in the soil from both forms of phosphate. The crop increases for the use of phosphates are large on all the fields except Mayfield where the effect was not very marked on corn. The tests will be continued until there is a wide difference in yields.

Rate-of-Liming Experiments. As heretofore, the heavily limed plots yielded less of corn, tobacco and clover. Apparently wheat withstands extremely heavy applications of lime without injury. Clover, regarded as a lime-loving plant, showed the greatest reduction in yield from heavy liming, altho corn yields were depressed nearly as much. Reduction in yield does not occur, however, with applications of less than 10 tons per acre. The effects of heavy liming on tobacco are most serious because of the great reduction in quality. Yield was not affected; in fact, the heavily limed plots were among the highest yielders. The following figures for the 1933 crop show the extent to which quality of tobacco was reduced by heavy liming.

Limestone, Tons per acre	Price of Tobacco per lb., Cents	Acre Value of Tobacco
None	12.6	\$177.00
5	11.8	168.60
10	10.6	155.60
20	6.8	96.80

Manuring Experiments. The last three years' results show that 4 tons of manure per acre applied on corn ground increased the yield approximately 12 bushels per acre but that 6, 8 and 10 tons per acre produced no appreciable increase over 4 tons. The yield of wheat following corn was increased approximately 5 bushels per acre by 4 tons of manure applied on the corn ground. The larger applications for corn increased the yield of wheat by about 2 bushels, 6 tons being about as effective as 8 and 10 tons. These results are in close agreement with results for the preceding 12 years. Manure applied on wheat in the early winter has not been appreciably more effective on wheat than when applied for corn, but has been far less effective on the corn following in the rotation. The same is true when manure was applied on young clover after wheat harvest. In both the latter cases the clover was increased somewhat but not greatly, as compared with applying manure on corn ground.

The Lexington Soil Experiment Field. In changing the rotation from corn, soybeans, wheat and clover to corn, wheat and alfalfa for two years, eight cuttings of alfalfa, made before the crop was affected by the manure (8 tons per acre) used on the corn (in a rotation of corn, wheat and 2 years of alfalfa), showed 385 pounds gain per cutting for 200 pounds per acre of muriate of potash applied when wheat was sown. Four cuttings made after alfalfa followed manured corn, showed an increase of 170 pounds per cutting for potash. To have yields as free from weeds as possible only the second and third cuttings were weighed each year. Always three cuttings were made and sometimes four. The total effect of potash on all cuttings was

therefore 50 to 100 percent greater than the figures given. Potash had only a slight effect on the crops of the former rotation.

The average yield of wheat following corn in this rotation was 26.6 bushels for 1932-34. The average yield for 1911-31, when wheat followed soybeans, was 27.1 bushels. Other yield data show seasonal conditions for 1932-34 to be about average for the preceding period. The average yield of corn following alfalfa for 1933-34 after the rotation was fully established was 73 bushels per acre.

Rotation experiments begun in 1920 included a study of the effect on productiveness of clover and soybeans in rotation with corn and wheat. The yields for the first three years (1921-23) and the last three years (1932-34) are as follows:

Rotation	Corn Bus.	Wheat Bus.	Hay* Lbs.
1. Corn, wheat, clover			
First period	50.4	20.4	
Last period	66.5	19.1	2600
2. Corn, wheat, orchard grass			
First period	44.9	21.0	
Last period	60.4	16.1	1267
4. Corn, wheat, soybeans			
First period	53.1	19.6	
Last period	52.2	15.8	4363
5. Corn, soybeans, wheat			
First period	45.9	19.6	
Last period	53.8	15.6	3905
7. Corn, wheat, clover (Duplicate of No. 1)			
First period	47.6	22.1	
Last period	62.8	18.5	2424

* Average for 14 years.

In the 14 years of the rotation, clover was a complete failure three times, and practically a failure twice. Clover main-

tained the yield of corn decidedly better than soybeans, and the yield of wheat somewhat better. The beans produced much more hay. If the manure made from feeding these crops had been returned, probably the soybeans rotation would have maintained the yield of corn and wheat as well as the clover rotation or better.

Wheat. Extensive comparisons were made of bearded and beardless varieties. The wide differences in yield obtained in 1933 did not occur this year, but the highlyyielding beardless varieties in 1933 were again all close to the top in yield.

About 20 years ago a strain of Currell's, designated as Station Strain R 47, was distributed in western Kentucky and is widely used and very popular. It is superior to ordinary Currell's in quality and uniformity of grain, and, according to Station tests, in yield. However, like its parent, it is not sufficiently winter hardy to survive some winters without serious injury. Another selection from Currell's made a few years ago and designated as Station 31-10 seems to have all the desirable characters of R 47 which it closely resembles, and is winter hardy. In the short time this strain has been under test, it has given exceptionally good yields of high quality grain. If it continues its good record it may well replace R 47.

In the winter-hardiness nursery conducted in cooperation with the Bureau of Plant Industry, U. S. D. A., much information was obtained this past winter regarding the relative hardiness of common wheat varieties grown in this country. Three brief periods of zero weather at times when there was no snow protection were very trying on wheat. While crowns and roots escaped serious injury except with a few varieties, the top growth was killed on all except the very hardy varieties. The degree of killing was a good measure of relative hardiness. The hard winter wheats, Turkey, Kanred, etc., adapted to the western hard winter-wheat belt escaped with little injury. Among the soft wheats only Minhardi, a variety developed in Minnesota, equaled the hard winter wheats in resistance to cold. Because of its late maturity it is not adapted to this latitude. Kawvale and Purkof ranked next to Minhardi, and the widely

grown varieties, Michigan Amber and Harvest Queen, showed very little winter injury. Such varieties as Fulcaster, strains of Fultz (Trumbull, Fulhio and Ashland), Gladden, Poole, Nabob, Forward, Nittany, and the Mediterranean selections, suffered almost complete killing of the tops but the crowns escaped much injury. Purple Straw and Southern Red May were almost completely killed, while Leaps and Red Rock suffered 15 to 20 per cent killing. In the regular variety tests on the farm, the stand of Currell's was thinned considerably while the Bluestem Fultz proved to be very hardy

Corn. Numerous single, double and top crosses produced from the Station's inbred strains and obtained from other sources, were tested. As in past years many of the crosses gave higher yields and much sounder corn than any of the open-pollinated varieties. None of the double crosses yet developed was quite equal to some of the single crosses, being inferior in both yield and quality of grain. Top crosses, that is, crosses produced by crossing an open-pollinated variety with a selfed strain, did not show up so well as similar crosses did last year except in a few instances. Double-crossed seed of yellow strains from Missouri gave large yields but the grain was not sound. Crosses produced by commercial firms in the Central Corn Belt were too early maturing to give very large yields in Kentucky as compared with Kentucky Station crosses from later-maturing inbred strains. Seed of a number of the best crosses were distributed to farmers in various parts of the state and several very complete tests were made.

Barley. From a rather large number of pure line selections for winter hardiness, made from our ordinary local winter barley, two have finally been chosen, designated as Kentucky No. 1 and No. 2. In plot tests they have consistently given good yields of excellent grain and probably are as hardy as any winter barley in existence in this country. Much of the winter barley in Central Kentucky was winter-killed last winter, but No. 1 and No. 2 came thru with a perfect stand. Several lots of No. 2 have been distributed in the state and have made a

good record. On the Lexington soil No. 2 produced 56.5 bushels an acre in 1933 and 51.5 bushels in 1934.

Oats. A variety of spring oats produced by the Station, designated Kentucky No. 4, produced 48.5 bushels an acre in 1934 as compared with 39.4 bushels for commercial Burt. Columbia, a variety developed at the Missouri Experiment Station gave 48.3 bushels per acre. These yields were remarkable for 1934 when most fields of oats in Kentucky were not worth harvesting.

Alfalfa Failure. Thirty certified alfalfa varieties and strains sown in 1933 differed in winter resistance from loss of half the stand to apparently complete winter hardiness. Common alfalfas from the southwest were most severely injured and some of the more northern varieties of common were much injured. A few were completely hardy. The variegated alfalfas were quite winter hardy tho two were winter killed slightly.

Crown-Rot of Clover. In Kentucky Bulletin 341 on crown-rot of clover, mention was made of spring fruiting bodies (apothecia) which appeared in abundance in one field where mixed legumes had been planted. A further comparative study of the spring organism and *Sclerotinia trifoliorum* which normally produces fruiting bodies in the fall has shown them to be distinct. The organism fruiting in the spring corresponded closely in size of ascospores and rate of growth in culture to *S. sclerotium*. An improved method of growing the apothecial stage of both organisms was developed which should lead to a more complete understanding of why one organism fruits in the fall and the other in the spring. Sclerotia are planted in small glass vials on a plain agar slant on which the fungus or other contaminating organisms make very poor growth. Placed under proper temperature conditions, apothecia mature in the course of 3 weeks or more. Hundreds of apothecia of *S. trifoliorum* have been produced in vials set out of doors during the fall, while only an occasional vial containing sclerotia of *S. sclerotium* produced apothecia. Both species have initiated

stipes in the ice box which later developed into apothecia when transferred to light. Single-spore cultures of both organisms produced viable apothecia, indicating that both are homothalic.

Chemical Composition and Yields of Lespedeza. Korean and sericea lespedeza hays grown on the Experiment Station farm at Lexington contained 0.80 percent and 0.62 percent phosphorus pentoxide, respectively, while hay of same maturity harvested from an unproductive soil on the Western Substation at Princeton contained 0.28 percent phosphoric acid. These analyses clearly indicate that lespedeza hay grown on poor soil is likely to be seriously deficient in minerals for high-producing livestock.

Alfalfa and red clover contained approximately 70 percent of moisture when cut for hay, and Korean and sericea lespedeza contained approximately 60 percent of moisture when cut for hay. The relatively low moisture content of lespedeza explains, in part, at least, its rapid curing in the field.

In four comparative hay-producing tests in the state, Kobe lespedeza produced an average of 3 tons of hay to the acre, Korean produced 2.4 tons, and common 2.3 tons. Sericea lespedeza was included in two of these tests; it produced approximately the same average yield as Korean lespedeza.

Sod Webworm. Sprays made of pyrethrum, and kerosene emulsion, at proper dilutions, were fairly effective in killing the worms in bluegrass sods enclosed in cages. A kerosene emulsion, 1 to 10 dilution, killed nearly all the worms, but injured slightly the ends of the blades of the bluegrass in one test, though no permanent injury appeared. Lead arsenate used at the rate of 8 and 10 pounds in 100 gallons of water was fairly effective. Very thorough spraying was necessary to get the grass properly covered with poison. The lead arsenate spray appears promising for controlling the worms in bluegrass and should be given additional tests.

Adults were rather abundant from late July to late October, but severe injury to bluegrass was prevented by rains at mid season. The most numerous species were the bluegrass sod

webworm, *Crambus teterrellus*, the larger sod webworm, *Crambus trisectus*, and the striped sod webworm, *Crambus matubilis*. *Crambus laqueatellus* was fairly numerous on one sod plot at the Station farm, in the spring.

Poisoning White Grubs. Greenhouse tests were conducted with many poisons to determine their value in the control of white grubs in the soil. The results show that white grubs may be killed by certain gasses, by water-soluble poisons (contact), or by poisons which they eat while traveling thru the soil. Among the gases that kill are vapors or gas from carbon disulfide, paradichlorobenzene and naphthalene. Poisons that kill by contact include pyrethrum solutions, pyrethrum and rotenone combinations, mercuric chloride, cuprous cyanide, sodium cyanide and others. Among the stomach poisons, lead arsenate seemed to be more effective than calcium arsenate. Fluorine compounds in these tests seemed ineffective. Arsenicals that proved the most successful were lead arsenate and potassium arsenite. Nicotine was only partially successful at relatively high concentrations and under very restricted conditions. The type of soil, where the poisons were applied, was important. Soil containing admixtures of absorptive organic material required more of the water-soluble poisons. With admixtures of materials such as peat moss, poisons that are effective in ordinary soil may have no effect on the white grubs at all.

Combinations for Effective Insecticides. Experiments were carried out to ascertain if combinations could be made with nicotine that would be more toxic to insects than nicotine alone. Thus far experiments have been made with hydrogen cyanide, thiocyanate, strychnine, brucine, aconitine, digitalin, atropine and aliphatic isothiocyanates as the toxic substances, and oils, tars and clays as stickers, spreaders and adhesive agents. Forty-two different preparations having toxic properties have been made and tested in various concentrations on the Mexican bean beetle and the red spider. Some of these combinations with nicotine are much more effective on these two insects than a similar concentration of nicotine alone, when tested under

laboratory conditions. Eighteen clays and a few bentonites have been tested for their absorptive and retaining properties of nicotine. The bentonites retain nicotine for a much longer time than the clays and apparently have possibilities for commercial use as absorbents for nicotine.

A New Spreader for Nicotine. A new spreader, called Number 385, for use with nicotine and other contact sprays, was developed. It is liquid and, therefore, has advantages over hard soap. It is four to six times as effective as liquid soap spreaders and approximately $7\frac{1}{2}$ times as effective as the sulfonated oxidized mineral oils commonly used. The spreader is made by mixing together cold, oleic acid, a special pine tar oil (gravity 1.035), potassium hydroxide and ethyleneglycolmonoethyl ether. A most important feature is that this spreader may be combined with nicotine in manufacturing. It is necessary that the finished product be alkaline. The combination is liquid. The amounts of nicotine and spreader in such a product may be adjusted to practically any proportion. Only with a highly efficient spreader, such as 385, is such a combination practical or effective when diluted.

Spray Studies. A miscible oil formula was developed for use in dormant sprays where pressure apparatus, such as a power pump, is not available. The following ingredients are mixed by pouring or shaking: Part I—2.5 potassium hydroxide (caustic potash) 92% flakes, 3.0 amyl alcohol (fusel oil), 1.5 ethyleneglycolmonoethyl ether,¹ 1.5 water, 1.0 phenol; Part II—82.0 mineral oil,² 8.5 oleic acid. Mix Part I in the order given, being certain that the potassium hydroxide is dissolved before the phenol is added. Mix Part II separately and add it to Part I. Pour until the mixture becomes clear and looks like the original oil. If summer white oils are used, the amount of potassium hydroxide may be decreased to 2%. The proportion of water must not be increased or changed because if it is the

¹ Cellosolve is one commercial name for ethylene glycol mono-ethyl ether.

² Specifications for dormant oil: Viscosity between 125 and 200 seconds Saybolt at 100 degrees Fahrenheit; volatility less than 2 percent (loss for 4 hours at 105 degrees Centigrade). These oils are sold by oil companies at their bulk stations under such names as "agricultural spray oil", "orchard spray oil", "scale oil", etc., at about 16 to 20 cents per gallon.

formula may not work satisfactorily. This formula is especially well adapted for permanent combination of mineral oil and Bordeaux mixture where stability is an important factor.

Fruit growers in Kentucky have tried mixtures of oil and Bordeaux mixture for dipping, without success. Tests were conducted in 1934 with various stabilizers and preservatives for Bordeaux mixture and with dormant oil mixtures to determine the combination best adapted to this purpose. It was found that certain oils, sugar and soap were useful. The most useful stabilizer was sugar. Recommendations have been made for its use at 1 pound per 100 gallons of 6-6-100 Bordeaux mixture. However, the tests showed that sugar at that concentration caused the Bordeaux to break down eventually and release the copper into the solution, causing it to turn deep blue to indigo. Dosages of sugar even below 1 ounce per 100 gallons of 6-6-100 Bordeaux had some effect in preserving Bordeaux mixture. The most effective dosages in laboratory tests at room temperature proved to be between $2\frac{1}{2}$ and 5 ounces per 100 gallons. As a result of these tests, sugar is being used with Bordeaux mixture and also in regular dormant peach sprays, with the idea that the stabilized Bordeaux may be more effective in controlling leaf curl.

New Carriers and Diluents for Nicotine. An extensive trial was given to a number of fixed nicotine mixtures, such as the standard nicotine-bentonite combination, in the control of leafhoppers and aphids. Ten different combinations were used. In no instance was any of the combinations successful in controlling these insects. It was shown that tale was more effective as a diluent and carrier for nicotine, pyrethrum and rotenone than fullers earth, bentonite and tripoli, when used to control Mexican bean beetle or flea beetles. Very absorptive clays like fullers earth were difficult to use on mornings when plants were wet with heavy dew, if the machine drew air from around the plants.

Thrips Injury to Peach Nursery Stock. For many years it has been noticed that after peach nursery stock had made sat-

isfactory early growth, its development was suddenly checked. Examination disclosed an injury in the terminal buds and frequently in the lateral buds. This injury has been designated "Stop Back", because it was thought to be of bacterial origin. Observations during the past summer indicate that thrips are responsible in a large measure for this trouble.

Peach Orchard Drainage. No drainage records were possible, because of the light rainfall during the past year, 34.89 inches, at Princeton, and because rains did not saturate the soil at any time. Despite the dry soil condition that prevailed thruout the year, and the period of drought thru July, the peach trees did not appear to suffer from lack of water. They made good growth and produced a small crop, 542 bushels. The fruit matured to large size and was of excellent quality. To test the value of different methods of soil management the trees in this orchard were divided into ten plots. On all plots the trees made good growth but those in sweet clover or Korean lespedeza made less growth than those receiving cultivation and cover crops. In general, the set of fruit seemed to depend more on elevation than on soil management. The trees in the lower parts of the field produced no crop. The crop on the plots in sweet clover and in Korean lespedeza made the smallest yields despite the fact that they seemed to be about as favorably located so far as elevation was concerned.

Rosy Aphid of Apple. Tests were made in the Experiment Station orchard, on the effect of dormant sprays on the eggs of the rosy aphid which overwinters on the bark of twigs and limbs of apple. Commercial and homemade tank-mixed emulsions of coal tar oil and pine tar oil were used, both with and without mineral oil. With the tank-mixed emulsions, the most satisfactory emulsifier for the coal tar oils, or the coal tar-mineral oil combination, was a mixture of Bordeaux mixture ($1\frac{1}{2}$ - $1\frac{1}{2}$ -100), and a solution of soap (1-100). This emulsifier was even more satisfactory when used with the pine tar oils or with the pine tar oil and mineral oil combinations. Where coal tar oil and soap are present, the addition of a small amount of a common

solvent facilitates the making of the emulsion. The solvents differ for different fractions of oil. Other emulsifiers used for the tar oil or the tar oil-mineral oil combinations were oxidized and sulfonated mineral oils of several grades, sulfonated castor oil, and soybean flour. Soybean flour may also be used to advantage as an emulsifier with mineral oil alone.

Effect of Minerals on the Growth of Vegetables. Two squashes were examined, one grown with fertilizer composed of compounds of copper, manganese, zinc, boron, iodine, and ferric sulfate; the other grown in normal soil nearby without fertilizer. The squash grown with the fertilizer weighed more than three times as much as the one produced without fertilizer. Chemical analyses showed that the fertilized squash contained twice the percentage of iron in the edible portion as the one grown in normal soil. The percentages of calcium, potassium and nitrogen in the edible portion were considerably increased by the fertilizer treatment. This demonstrates that the mineral content and presumably the nutritional properties of the squash were considerably enhanced by the fertilizer treatment and shows that the less common elements are of economic importance in the production of foods of high nutritional potency.

A number of experiments were carried on with purified sand cultures to ascertain the necessity for and the function of copper in the growth of plants. The results show that copper performs a very important function in the growth of plants and that apparently it is vitally concerned in florification and the production of pollen in corn plants. The results gave evidence also, of the essential nature of copper in the economy of tomato, spinach and petunia plants. Analyses of the corn plants from which copper was excluded showed that they did not contain enough of this element to give a test with the Xanthate reagent. The plants to which copper was added contained .00095 percent of the element.

Variety Tests of Vegetables. Kings Crost Golden Bantam, Golden Cross Bantam and Golden Bantam were grown on a field known to be infected with Stewart's disease. Kings Crost

was found to be practically free of the disease. Altho the ears were small, the yield was good and the quality excellent. Golden Cross Bantam was less resistant, about 20 percent of stalks being affected. The ears were large and of excellent quality.

Golden Bantam was practically a failure, about 95 percent of the stalks were affected with the disease. It appears from this test and from observations over the state, that Golden Bantam should no longer be recommended; at least for areas where Stewart's disease is present. Kings Crost seems to be one of the most promising varieties of the Bantam type for Kentucky.

The Katahdin potato, despite an unfavorable season, produced at the rate of 232 bushels of marketable potatoes per acre. The French variety planted on the same date (June 13) produced at the rate of 128 bushels per acre. In view of the fact that the French variety has been found very productive in previous years, it appears that these two varieties of the "July" type should be given further tests in this state because this type of potato is especially adapted to the sections of the state outside the commercial areas.

The sweet Japanese, a melon of distinctly different type from the watermelons commonly grown, was found to make a vigorous growth and mature a large crop. The melons are very small, about the size of a Tip-top cantaloupe, and mature about 30 days earlier than Stone Mountain. The quality is excellent. If a small, early-maturing watermelon is desired, the Sweet Japanese seems more promising than any other variety tested.

Because of the shortage of onion sets on the American markets, a few sets were obtained from Greece. A greenhouse test of these indicates that such sets start growth promptly and grow vigorously. They should be desirable for the production of green onions in the home garden.

Tomato Seeding and Plant Test. The purpose was to determine the seeding date and method of handling seedlings that promote early maturity of the crop. The lot sown March 24, in which the seedlings were kept under conditions favoring

rapid growth, and set in the field May 10, produced the earliest and largest yield, in contrast with those seeded February 28, and set in the field May 10. Plants set out earlier were injured by frost. Seeding early and keeping plants a long time in the seed bed proved detrimental to early maturity and total yield. The Pritchard variety was slightly earlier than the Marglobe.

Raspberries. From spraying tests reported in 1933, it appeared that summer sprays of standard Bordeaux mixture had a marked beneficial effect. Three sprays were applied, July 5, July 31 and August 25, 1933. The final result from this test, obtained when these canes bore their crop in 1934, are shown in the table:

Plot	Treatment	Pruning after Harvest, 1933	Rate of Yield Crates Per A.
1	3 sprays 2-2-50 Bordeaux	No pruning	176.6
2	3 sprays 4-4-50 Bordeaux	No pruning	185.0
3	3 sprays 4-4-50 Bordeaux	Old canes removed	171.0
4	1 spray 4-4-50 Bordeaux	Old canes removed	90.0
5	No spray	Old canes removed	55.0

The increase in yield amounted to more than 300 percent on all plots sprayed three times. Altho the use of Bordeaux, at 2-2-50 strength, resulted in a good yield, the canes did not appear as healthy as those that had been sprayed with 4-4-50 Bordeaux. The canes on the unsprayed plot had lost most of their leaves by September, 1933, whereas the foliage of the sprayed rows was in excellent condition. By March, 1934, about half of the canes in the unsprayed plots were dead and the tops of the remainder had died back to 2 to 3 feet whereas

the sprayed canes suffered little loss. The removal of old canes immediately after harvest did not seem to be important. Altho summer spraying of raspberries has not been recommended heretofore, the harvesting results from this test are so outstanding that there can be no doubt as to the value of the sprays in Kentucky.

In the spring of 1933 a simple fertilizer test was applied to raspberries. The treatments consisted of the use of barnyard manure at the rate of about 20 tons per acre, and of sulfate of ammonia at the rate of $\frac{1}{4}$ lb. per hill, compared with a check receiving no fertilizer. The manure plot and the sulfate of ammonia plot produced practically the same yield, 151.6 and 152.0 crates per acre, respectively. The yield of the unfertilized plot was 97.3 crates per acre. The fertilizers increased the yield approximately 56 percent. Samples of berries from each plot were set aside for observation on the degree of softness and keeping quality. It appeared that the berries from the manure plot were slightly the softest and had slightly more mold than the others, after standing for several days. The berries from the sulfate of ammonia plot seemed about as firm as those from the unfertilized plot. The berries from the fertilized plots were somewhat larger than those that were not fertilized. While this is the result of only one year, it would seem that either of these fertilizers may be used profitably on soils that do not produce good cane growth.

Leaf-spot of Raspberries. Raspberries sprayed with Bordeaux mixture during the summer of 1933 retained their foliage much better than unsprayed plants, the leaves on the latter being destroyed by Septoria leaf-spot. Unsprayed canes of Latham died back during the winter about 85 percent while only about 25 percent of the sprayed canes died. In 1934, leaf-spot did not develop until about midsummer, but it defoliated unsprayed canes after that time. Sprayed plants retained their foliage. Chief appears to be somewhat more susceptible to Septoria leaf-spot injury than Latham and is more sensitive to winter injury following leaf-spot. Sprays following picking

and removal of old canes appear to be more beneficial than earlier sprays.

Dewberries. Two series of treatments were applied to dewberries: (1) spraying similar to that used on raspberries for the purpose of reducing the dying of canes thru the winter season; and (2) several methods of pruning the young canes which are to produce next year's crop. The spraying tests did not give the marked results found with raspberries and no significant differences were found in the yield of the sprayed plots compared with those that were not sprayed. The plot in which all young canes are cut back to about six inches in length, on July 4, produced the best fruiting canes, and the yield was about 20 percent better than that of any of the plots in which other methods of pruning were used.

Paratyphoid Bacilli. A preliminary study of *Salmonella anatum* demonstrated that it is diphasic. Specific and non-specific races were isolated. The specific phase is closely related to that of the Reading and Newport types. The non-specific phase resembles the group phase of the London type. The somatic antigens of *S. anatum* resemble the somatic antigens of the London and Sorftenberg types. Study of this species is being continued to determine its exact relationships.

Hemolytic Streptococci of Fowls. In a study of beta hemolytic streptococci from pathologic conditions in chickens, cultures were isolated from apoplectiform septicemia, laryngotracheitis and slipped tendon. The streptococci from apoplectiform septicemia and slipped tendon were found to be biochemically and serologically identical with the type A animal streptococci. This type of streptococcus is widely distributed thruout the various species of domestic animals. Streptococci said to have been isolated from infectious laryngo-tracheitis of chicks, received from another laboratory, could not be distinguished from streptococci of human origin by biochemical or serological methods.

Marl as a Source of Calcium for Laying Hens. The conclusion may be drawn from the data obtained in this experiment

that marls from Spencer, Green and Warren counties and high-grade limestone from Fayette county serve as good sources of calcium for laying hens. The work is not yet finished.

Hemoglobin in Hens and Hemoglobin-Forming Value of Eggs. Extensive studies were carried on to determine whether the many different constituents of the egg can be affected by treatment of the hen and, if so, to what extent. A very large number of variations and combinations of procedure could be undertaken. The almost unlimited possibilities made it necessary to restrict studies to (1) observation of the effect of variation in the source of Vitamin D on the Vitamin D content of the egg yolk and on the calcium, phosphorus, iron, copper, lecithin, cholesterol and pH of egg yolk; (2) the effect of such variation on the copper and iron content of the tissues of the hens laying the eggs; (3) the effect on egg yolk of adding known amounts of copper and iron salts to the ration of the hens; (4) the effect of such additions on the tissues of the hen, and (5) the hemoglobin-forming properties of the egg yolks produced under the different conditions.

Earlier work indicated that when egg production of young hens is high and the copper and iron content of the egg is high, the hemoglobin content of the blood tends to decrease. This may mean that the result of heavy production is to deplete the constituents necessary for hemoglobin formation. Therefore, the experiment was tried of adding copper to the ration of one lot of hens, iron to the ration of another lot and copper plus iron to that of a third lot. The hens that were fed both iron and copper laid the largest number of eggs per hen, and the hemoglobin content of their blood increased 0.5 percent. Altho confined, they laid 15 percent more eggs per hen than the hens on bluegrass range. Confined hens that received either iron or copper laid more eggs per hen than confined hens that received neither. The hemoglobin content in the blood of the hens that were fed iron, copper, or both, did not decrease, even when egg production was high. From previous observations, decrease in content of hemoglobin was to be expected with increase in egg production.

Previously collected data also seemed to indicate that to some extent cod liver oil had an effect of protecting the hemoglobin of the hen from depletion, even tho egg production was high and the copper and iron of the egg yolk high. To determine whether the results obtained may have been due to some other substance in the oil than vitamin D, four pens of hens were given commercial stearin as a source of D. All the hens showed higher egg production and higher hemoglobin values than those fed cod liver oil, whether or not they were exposed to sunshine or had bluegrass range or were fed extra copper or iron supplements. Possibly the stearin contained more vitamin D than the cod liver oil, or other substances necessary for the best utilization of iron and copper.

An experiment was conducted to test the efficacy of the egg yolks produced under controlled conditions. The results of this one test showed that both fresh and ashed egg yolk are good hemoglobin producers but that neither is so effective as iron and copper salts.

Vitamin D Studies. Leghorn pullets kept under three sets of conditions, (1) confined, (2) allowed direct sunshine, and (3) on bluegrass range, were fed an all-mash ration. To the mash given one pen of each pair 2 percent of cod liver oil was added. The results showed a decrease in embryo mortality during the third week of incubation when cod liver oil was added presumably due to the vitamin D factor which aided in the assimilation of calcium and phosphorus. The addition of cod liver oil did not decrease embryo mortality during the first and second weeks of incubation, the cod liver oil pens showing a slightly higher mortality. Addition of cod liver oil decreased the proportion of malpositions of the embryos.

Incubation of Turkey Eggs. During the 1934 hatching season, approximately 6,000 turkey eggs were hatched under experimental conditions. In a sectional incubator the highest hatchability was observed when the temperature was $100\frac{1}{2}^{\circ}$ – $101\frac{1}{2}^{\circ}$ – $102\frac{1}{2}^{\circ}$ – 103° F. the first, second, third and fourth weeks, respectively (bulb of thermometer level with top of

eggs). A temperature of 101° F. thruout incubation did not give as good hatchability. A temperature of 104° F. the fourth week of incubation increased the embryo mortality that week. Hatching the eggs large end up in a forced-draft incubator (trays full), without candling, did not increase the hatch and necessitated extra labor at hatching time to avoid loss of poults. If the hatching trays of a forced-draft incubator were moderately filled with eggs resting on their sides, nothing was gained by reducing the number of eggs per tray to half and thereby allowing more room and air for the newly-hatched poults.

Outcrossing Rhode Island Reds. The study to determine the effect of crossing unrelated strains of Rhode Island Red chickens has been carried into the second generation, a control pen of the pure Kentucky strain being maintained. The original outcrosses were made from three outstanding strains of the breed. Foundation cockerels were obtained from: (1) an Iowa record-of-performance flock bred for a combination of high egg production, large eggs and good color; (2) a Massachusetts flock in which egg production, egg size and vitality were stressed, while standard color played no part in the selection, and (3) an exhibition strain in which winter egg production as well as deep red color had been a factor in selection. The four foundation cockerels were mated to pullets during the first breeding year at the Robinson Substation. During their yearling year, they were bred to hens (yearling and older) at the Experiment Station farm. The Iowa outcross gave no increase over the Kentucky strain in winter egg production and only a slight increase in yearly egg production, whether mated to pullets or selected hens. The Massachusetts outcross resulted in a slight improvement in winter egg production, but there was a material falling off in fertility and hatchability as well as a loss of the deep, rich red color of the Kentucky strain. The exhibition outcross resulted in a slight increase in both winter and yearly egg production and some improvement in color and type. The results indicate that it is possible to combine early maturity, high egg production, good egg size, and high hatchability, with the stand-

ard color and conformation requirements of the Rhode Island Red breed.

Parasites of Horses. Examination of 748 samples of fresh feces for parasite eggs, showed that the majority of the horses examined were heavily infested with nematode parasites of the digestive tract. The flotation method was used, with glycerine or sugar solution as a diluent, and the mixtures were centrifuged. The examinations were used to estimate the kind and degree of nematode infestation in the horses examined, not to determine the exact number of eggs in a given amount of material. Duplicate preparations set up at the same time, and repeated daily and weekly examinations on the same animal, gave quite uniform results.

Colts that showed a high ascarid egg count were uniformly negative following treatment with carbon disulfide, but the egg counts of strongyles and related species, after treatment, were not often negative, tho usually they were lowered 75 to 90 percent. On horse-breeding farms where fresh stable manure is not spread on the fields and the animals are treated regularly and systematically for ascarids, subsequent crops of foals were less heavily parasitized. A longer time was required for the effect of control and preventive measures to become noticeably apparent upon strongyles and related species. The egg counts from colts raised on farms where preventive measures and regular treatment have been followed for three and six years averaged only half as high as those from colts raised where no preventive measures were followed. There was a noticeable improvement in the general health and growth of the colts each year over the preceding crops, and it was possible to maintain a satisfactory growth and rate of gain, upon considerably less grain.

Rye Pasture versus Bluegrass Pasture for Ewes with Lambs.

On January 3, 1934, 16 bred ewes were put on rye pasture, and an equal number on bluegrass pasture. The average weight of the ewes in each lot was 82.4 lbs. They were given alfalfa hay from January 8 to April 30. The average amounts eaten, per

ewe, were 112 lbs. for those on rye, and 119 lbs. for those on bluegrass. Sixteen lambs were dropped in each lot and fifteen in each lived to the end of the experiment. The average weight of the lambs from the ewes on rye exceeded that of those from the ewes on bluegrass by about one pound each, at birth, and by two pounds at the end of the test. In the same time, the ewes on rye had made an average gain of one pound each more than those on bluegrass. The results suggest a slight advantage for the rye pasture.

Profitable Lamb Production. A study of 99 flocks in Owen County showed that the following practices were profitable: (1) Drenching the ewes; (2) running not more than 25 ewes per ram; (3) culling and replacing to keep at least two-thirds of the ewes 2 to 5 years old; (4) turning the ram with the ewes by September 15, and (5) selling at least 80 percent of the lambs by September 1. Seventeen farmers who followed most or all of these practices made an average net return of \$1.72 per ewe as compared with 21 cents per ewe for 29 farmers who followed none or only one.

The records of 43 sheep flocks in the Central Bluegrass Region showed that eight farmers who followed three or all of the following practices: (1) producing at least 109 lambs for each 100 ewes; (2) raising at least 87 lambs from every 100 born; (3) running not more than 24 ewes per ram, and (4) trimming the lambs, made a net return of \$3.18 per ewe as compared with \$1.90 per ewe made by 13 farmers who followed none or only one of these practices.

Sheep Diseases. Autopsies were held on fifty-six animals from forty-seven flocks numbering 4572 sheep. Fourteen diseased conditions were diagnosed: acidosis of pregnant ewes, 27.6 percent; stomach worms, 21.2 percent; a condition tentatively called ictero-hematuria, 10.6 percent; plant poisoning, 8.5 percent; malnutrition, 8.5 percent; pneumonia, 6.4 percent; and eight other conditions, 17.2 percent. In ten flocks the loss was due to stomach worms. Of these ten flocks five had been

treated and five had not. Of the flocks treated, two had been given tetrachlorethylene twice, five days and two weeks, respectively, before time of autopsy; the loss was 12 percent with no apparent improvement of flocks. In a flock of sixty-four reported treated three times with an iodine solution, the loss from stomach worm infestation was about 11 percent. In a flock of fifty-eight reported treated with a solution of Black Leaf 40, the loss was about 12 percent, and in a flock of twenty-seven, treated with copper sulfate solution, the loss was 18 percent. In no instance did the owner know the true strength nor exact composition of the preparation used. In the untreated flocks, comprising 327 animals, the loss reported at time of autopsy was 8 percent. While the loss reported for the untreated flocks is much less than that for the treated flocks it was apparent that the degree and extent of stomach worm infestation was much less than in the treated flocks.

Late-cut versus Early-cut Soybean Hay for Wintering Steers. Twenty young steers of medium to good quality, housed in a shed open on one side to a yard paved with concrete, were fed for 107 days on a ration of 10.45 lbs. of corn silage and 3.67 lbs. of broken ear corn, each, with all the soybean hay they would eat. At the start, the steers were divided, as evenly as possible as to weight, into two lots of 10 each, one of which was given early-cut, and the other late-cut soybean hay. The average of three weighings was used as the initial and final weights. The results may be stated as follows:

Soybean Hay Fed	Hay eaten per steer per day, lbs.	Av. Wt. of Steers, lbs.		Grain per steer per day, lbs.	Pork per steer per day, lbs.
		5/10/34	12/14/33		
Late-cut	10.6	572.5	402	1.59	0.7
Early-cut	7.6	544.0	399	1.35	0.5
Difference per steer	3.0	28.5	3	0.24	0.2

The early hay was cut just after the plants had bloomed; the late, when the beans were about three-fourths matured.

Both kinds were cured without rain. Chemical analysis gave the following results:

Analysis of Soybean Hay	Early-cut	Late-cut
Water	8.9	8.5
Ash	7.7	7.6
Protein	13.4	14.6
Nitrogen-free extract	34.2	31.5
Fiber	34.1	33.7
Fat	1.7	4.1

Bang's Disease. Of 21,004 samples of blood tested for Bang's disease by the agglutination method, 85.7 percent were negative, 11.9 percent positive, and 2.4 percent suspicious. This includes both initial and retests. Of 2181 cows tested for the first time, 70.1 percent were negative, 25.6 percent positive and 4.3 percent suspicious. A retest of 7018 cows, negative and suspicious on first test, showed 91.5 percent negative, 6.2 percent positive and 2.3 percent suspicious. In the retest group were a few animals that were positive on first test, which tends to raise the percent of reactors found on retest. For Kentucky the average reactors in herds tested for the first time is approximately 25 percent. The average reactors on retest of animals negative and suspicious on first test, was approximately 6 percent. In another group of 40,390 agglutination tests, rapid method, the percent of negative reactors was 83.6, positive reactors 11.0, and reactions interpreted as suspicious 5.4. The blood samples were mainly from herds tested for the first time, altho some had been tested previously and reactors removed.

Delayed Conception and Sterility in Dairy Heifers. During the past two years four lots of heifers have been grown to breeding age in accordance with generally accepted methods of feeding and management which provided for normal growth and development. In one lot the green feed was supplemented with 2 percent by weight of a mineral mixture of special steamed bone meal, flowers of sulfur and potassium iodide. Another lot was fed roots, and the third lot was given a max-

imum of sunshine. None of these variations in husbandry materially improved breeding efficiency as compared with the check group.

Tests of Milk Drawn Aseptically. Including tests in former years, 592 samples, from 149 cows, have been tested. The bromthymol blue test for mastitis gave a positive reaction in 43 percent of the samples from cows that reacted positively to the agglutination test for Bang's disease, and in 3.4 percent of the samples from those that did not react to the agglutination test. The average for all was 12.5 percent. The average leucocyte count for those that reacted to bromthymol blue was 2,326,000, and for those that were negative to that test, 39,500. The average for all was 639,000.

Quality of Butter as Related to Grade of Cream. During the two years ended May 31, 1934, butter from a commercial creamery was graded at the Experiment Station and the grade of cream used in making each batch was ascertained later from the records of the creamery. The average score of the butter made from 4-day cream only was 89.9, whereas that from the group containing 81-99 percent of 4-day cream was 89.1. Analyzed statistically, the data gave a correlation of $.4351 \pm .0187$, between the percentage of 4-day cream in the churnings and the score of the butter.

Cost of Producing Milk and Butterfat. The records of 15, 19 and 21 herds, for 1931, 1932, and 1933, respectively, were studied. During the 3-year period the cost of feed was 57 percent of the gross cost of producing milk and butterfat; man labor, 17 percent and other costs, 26 percent. Depreciation of the dairy cows was 16 percent of the gross cost in 1931 and 8 percent in 1933. Since 1931, '32 and '33 were years in which the value of dairy cattle was declining, the depreciation figures represent not only the cost of one year's use of the dairy cow but also part of the fall in market value. A comparison of 14 herds for which complete records were had for 1932 and 1933 showed that while production per cow was maintained, income per cow fell off because of a decline in price of milk from an

average of \$1.43 per cwt. in 1932 to an average of \$1.38 per cwt. in 1933. To meet this price decline these dairymen reduced their production costs. As a result the net returns per cow averaged approximately \$26.00 for both years. The lower cost of producing milk during 1933 was made possible (1) by feeding less grain and (2) by feeding more farm-grown grain and less of expensive purchased concentrates.

Pastures for Hogs. From May 17 to June 28, three lots of 20 pigs each, having an average weight of 42 pounds, were pastured, one on a good stand of oats and rape, one on bluegrass, and the third on alfalfa. Each lot was handfed 3 percent of its live weight of shelled corn. The average daily gains were: on oats and rape, .39 pound; on bluegrass, .23 pound; on alfalfa, .33 pound. The weights of grain required to produce a hundred pounds gain were 360 pounds, 587 pounds and 432 pounds, respectively. From June 28 to September 30 ten representative pigs from each lot were kept in a new field of alfalfa, and were fed 3 percent of their live weight of corn. The average daily gain per head of the pigs that had been on rape and oats was .55 pound; of those that had been on bluegrass, .54 pound; of those that had been on alfalfa, .62 pound. The average daily gain of the respective lots thruout the two tests were: .466 pound for those originally on oats and rape, .386 pound for those originally on bluegrass and .475 pound for those originally on alfalfa.

Comparison of Narrow and Wide Nutritive Ratio in Hog Feeding. Of two lots of 10 pigs each that averaged 111 pounds per head at the beginning of the test, one was started with a ration having a nutritive ratio of 1:6 and this was widened three times during the test according to an established feeding standard. The final nutritive ratio was 1:6.6. The second lot was started with a nutritive ratio of 1:8.3 which was widened three times according to a proposed new standard. The nutritive ratio toward the end of the experiment was 1:9.1. The first lot made an average daily gain of 1.41 lbs. The average daily consumption of feed was 5.58 pounds of corn and .5 pound of

tankage. This lot required 394.5 pounds of corn and 35.3 pounds of tankage for each hundred pounds gain. The second lot made an average daily gain of 1.18 pounds and consumed daily 5.57 pounds of corn and .15 pound of tankage, each. This lot required 469.5 pounds of corn and 12.4 pounds of tankage for each hundred pounds gain. The second lot required 75 pounds more feed per hundred pounds of gain than the first.

Profitable Pork Production. A net return (above feed, labor and other costs) of 32 cents for each hundred pounds of pork produced was made by seven Union County farmers by the following practices: (1) Continuous full feeding, (2) sanitation and raising a large percentage of the pigs farrowed. In the group of 29 in this study eight farmers who did not follow these practices failed by 64 cents per cwt. to meet the gross costs.

A New Weed. *Galium pedemontanum*, Carlo Allioni, reported last year on a farm in the Bluegrass region, has since spread considerably in the original locality and has been found also on a place several miles distant. The following description should enable persons to identify the new weed. *Galium pedemontanum*, All. Annual or winter annual. Stem weak, erect or straggling, rarely branched, four-angled with white hairs and retrorse spines on the angles, 2-7 dm. tall. Leaves sessile, verticillate in fours, ovate, obtuse, ciliate, 5-10 mm. long, 2-3 mm. wide, strongly reflexed except those near the tip, midrib white and conspicuous on lower side, larger leaves occasionally show a longitudinal vein on each side of the midrib, both surfaces with long white hairs. Pubescence most striking on young leaves near the tip of the stem. Flowers axillary, small, white, corolla rotate, four-lobed, peduncles at first erect, then curved downward, beset with long, white hairs. Fruit dry, didymous. Seeds button or mushroom-shaped, round and convex on the back, concave and hollowed out below, $3/4$ to 1 mm. in diameter,

dark brown, not spiny nor tuberculate, but slightly roughened or granular, sometimes with a few pale, appressed hairs, occasionally the long, white hairs of the peduncle remaining attached. Occurs in pastures, lawns, fence-rows, Clark and Fayette counties, Kentucky. In bloom May 29, mature seed July 18. Between these dates the tip is still in flower while seeds are ripe low on the stem. After midsummer the plants die and dry, prickly stems remain in conspicuous patches, under which numerous, tiny green seedlings may be found by August 2. A preliminary test indicates that the weed may be killed by spraying with iron sulfate, 2 pounds to a gallon of water.

Nursery Inspection. The condition of nursery stock in general is rather poor because of neglect, excessive heat and lack of rains during July and August. No new, serious insects or diseases attracted attention this year, with the possible exception of gladiolus thrips, which is not new but has been spreading over Kentucky for the past few years, especially since 1932. There were more requests this year for control measures for this insect than for any other. San Jose scale is under better control than in past years. Only a few infestations were noticed in the nursery, and these were slight. Practically all growers of fruit stock are spraying or dipping regularly for the control of this pest.

During the past season, there were 165 inspections of growing stock, totaling 1,057 1/4 acres. Certificates were issued to 71 residents, 83 non-residents, and 6 specials. Licenses were issued to 19 agents and 51 dealers. Two nursery dealers were prosecuted for violation of provisions of the nursery inspection act. Fines were assessed against both.

Seed Inspection and Analysis. The number of samples received for examination was 5,845. Purity tests were made upon 3,882 samples and 3,698 samples were germinated. The unusually large number of samples handled was due to an arrangement with the Regional Agricultural Credit Corporation to

analyze lespedeza samples as a basis for making loans to farmers. The distribution of samples tested was as follows:

Grasses	708
Clovers	3430
Vegetables	143
Large seed (Corn, Soybeans, Cowpeas, etc.).....	366
Tobacco	916
Collector's samples	282

Four cases involving violations of provisions of the seed law were prosecuted, and in each the party was found guilty and fined.

Feed Control. Consumption of commercial feeds has not increased over that of 1933. This may be due partly to the utilization of home-grown materials by feeders, a practice more closely adhered to than in previous years. However, the price level has increased considerably over that of 1933. The repeal of the 18th Amendment, permitting the manufacture of liquors and beers, has made available for Kentucky feeders a large tonnage of distillers' and brewers' dried grains. These products are high in feed value and may supplement home-grown materials and other low-protein materials used in dairy feeds. However, only a relatively small portion of these by-products is used by dairymen in the state, the bulk of these dried grains being shipped to other states where there is apparently a greater demand.

Chemical and microscopical examinations covering 1175 samples were made. Of this number, 767 were official samples taken for check analyses against guaranties of manufacturers. The remaining 408 samples were analyzed for feeders, for departmental investigations, for other departments of the Experiment Station, including co-operative projects, and for federal and state feed officials, including collaborative work of the Association of Official Agricultural Chemists. The demand for this work is indicative of the wide interest in feedstuffs and their use.

The inspection and analytical results show that in the main feeds are free of adulteration and misbranding, that they are of

high standard in quality, and that the manufacturers are making feeds well within their guaranties. The feeders of Kentucky are able to get high-class feeds if they want them.

No cases were filed in court during the year. One Federal case was concluded in favor of the Experiment Station.

Fertilizer Control. Five hundred and forty-five brands of fertilizer were registered, for which 2,227,000 tags were issued. Analyses were made of 707 samples of fertilizer submitted by farmers and inspectors.

Public Service Laboratories. As has been true each year since the establishment of these laboratories in 1918, the work shows a substantial increase over the previous year. Much of the additional work this year has come from the numerous CCC Camps in the State. The increase in work has been particularly heavy in the bacteriological laboratory where, to December 1, the samples numbered 18,216 more than for 1933. This increase has been due largely to the requirement of the Kentucky Emergency Relief Administration, that before anyone will be given employment in making mattresses, quilts, sewing and food work, he must have a medical examination and show a health certificate as being free from any infectious or contagious disease. This has required the examination of thousands of specimens for syphilis, gonorrhea, diphtheria and septic sore throat, tuberculosis, urine and feces for typhoid carriers, etc. The following tabulation indicates the volume and type of work handled by the bacteriological laboratory:

Wassermann tests	51,224
Kahn precipitation tests	47,681
Throat cultures	8,419
Agglutination reactions	4,910
Microscopical examinations	13,704
Bacteriological cultures	1,148
Bacteriological examination for sanitary quality	5,882
Miscellaneous, urine, spinal fluids, etc.	1,672
Total	134,640

The work of providing an ample supply of sterile specimen containers for such a large number of tests is no small item in itself. During the year, 76,810 containers were furnished.

Examination was made of 939 samples of food. Among the kinds of adulteration noted were the addition of water to milk, partial skimming, excessive moisture in butter, the presence of undeclared benzoic acid in pops and similar products, hamburger meat containing sulphites and undeclared cereal, and short weight and volume in a number of instances.

In the drug laboratory 291 investigations were made, comprising patent medicines, miscellaneous drugs, poison investigations, toxicological examinations, beer, gin, washing compounds, disinfectants, weed killers, soaps, paints, oils, gasoline, cleaning fluids, chemical examination of water for stream pollution, water treatment for municipal use, and to determine for the Game and Fish Commission cause of the killing of fish.

Total examinations made by the food, drug and bacteriological laboratories of this department, 135,870.

Creamery License. The object of the Creamery and Testers License law is to ensure the use of accurate weights and tests of milk and cream in the traffic between producer and buyer. The interests of both parties are protected. In the inspection of testing operations at milk plants, methods of sampling and of keeping records were examined for sources of error. During the year 9 plants were required to change their methods to comply with regulations. One plant made up differences in payments to producers because of errors in records. The manager and tester of another plant were called before the Examining Board, by which both were placed on strict probation. By the use of bulletins, circulars and personal instruction operators were informed of the approved methods of testing. In the inspection of cream-buying stations the operators were advised of the necessity of complying with them and the importance of quality improvement.

Eight hundred and fifty-two inspections were made, in-

cluding 12,501 individual tests. From the findings at these inspections the operators were graded as follows: A, B or C, 702; D (probation), 124; E (operators to be called before the Examining Board), 26. Testing equipment calibrated for accuracy numbered 23,275 pieces. Of these 97 were rejected. Eight test scales, 5 centrifuges, 3 thermometers and 2 pairs of dividers were condemned and 87 pieces were required to be repaired or replaced.

The Examining Board considered the cases of 26 operators because of inaccurate testing and violation of regulations. The licenses of 12 testers were revoked, 9 testers were placed on strict probation with provision for revocation of license if future inspections were not satisfactory; action on 2 cases was postponed until the next meeting and 3 cases were filed, as the operators had discontinued testing. One request for reinstatement was denied.

Licenses to buy milk and cream on the butterfat content were issued to 11 creameries, 7 cheese factories, 6 condenseries, 50 milk plants and ice cream manufacturers, 71 independent operators of cream stations, and 1034 cream stations operated by creameries. These total 1179, of which 1113 were renewals and 66 for new buying places that had begun operation since June 30, 1934. Permits in lieu of license to test, pending examination, and now in force were issued to 56 operators of the Babcock test; 230 applicants were issued new licenses and 971 operators were issued renewal licenses, all of which expire June 30, 1935. Examinations for applicants for license to test were held as follows: Bowling Green, 4; Cincinnati, 1; Marion, 1; Lexington, 5; Louisville, 3; Mayfield, 2; Maysville, 2; Owensboro, 3; and specials, 24; a total of 45. At these examinations 512 operators were notified to appear, 336 appeared and 309 or 92 percent made passing grades.

The receipts for the year were \$10,843.87 and the expenditures \$9,164.39, as itemized:

Salaries	\$6,752.01
Labor	478.82
Postage and stationery	332.53
Freight and express	14.66
Sundry and laboratory supplies	105.56
Travel	1,463.39
Contingent	8.00
Scientific equipment	9.42
	\$9,164.39

ROBINSON SUBSTATION

Forestry. The continuance of the Civilian Conservation Corps camp made available sufficient labor to undertake and complete a large amount of work in the construction of fences, temporary buildings, truck and foot trails and many bridges. A lookout tower on Boarding House Knob on Clemons Fork was completed. The altitude of the knob is 1,541 feet and the tower is 99 feet and 9 inches high. Thirteen and seven-tenths miles of truck trails were completed and ten miles partially completed.

A number of bridges were constructed on the main or lower Buckhorn trail. The one across Troublesome is 16 feet wide and has three stone piers and two stone abutments. There are two "feeder" bridges on Lower Buckhorn, one at Noble post-office and the other at the Noble schoolhouse. Three low-water bridges were built. The purpose of these is to afford a dry crossing during average winter stream flow. Freshets are presumed to flow and carry drift over the top of them. The floors of these bridges are inclined upwards with the stream to produce pressure as high water flows over them. Two of these are on Upper Buckhorn at Miller Branch and at Grassy Bottom. Both are anchored with one-inch steel cables. The third is on Coles Fork at Station 92+00, just below Ball Branch. If these bridges withstand the current winter, more of them will be built.

A more accurate measurement of the acreage of fires was made during the past year than heretofore. Likewise recorded

data are somewhere near what had been hoped for previously, which is essential to an intelligent future handling of the forest.

The following compilation shows the number of fires and burned acreage from 1925 thru 1934.

Year	Fires	Area burned, acres
1925		1,115
1926	35	835
1927	30	447
1928	32	182
1929	32	96
1930	38	145
1931	48	285
1932	37	660
1933	44	339
1934	40	162
Total	336	4,266
Average	37.3	474

The weather and growing conditions in 1934 assisted in preventing fires, which accounts for the comparatively low burned acreage. There were some intensely dry periods but they were of short duration. In general, passage to and from fires was greatly facilitated by roads and motor transportation.

Most of the dead chestnut was removed and more than 53,000 board feet are in pile. Posts cut from the forest were used extensively in fence construction at the Robinson Substation and at the Experiment Station at Lexington; the lumber was used for bridge flooring, camp ground facilities, barn repairs and many miscellaneous purposes.

Experimental planting plots were marked this year with 2x4 chestnut stakes painted white at the top and showing the year of planting and the plot number. Some of the hardwood plots have been abandoned. With two exceptions, the red oak and black locusts, hardwoods planted may be considered a failure. In the arboretum plots, some fine growth is noted in lob-

lolly pine, slash pine and red oak. Of the conifers, Japanese larch is apparently a failure, and the Japanese red pine with a fair record on paper, is still not prepossessing, for it often has two stems and is very subject to insect depredations. General observation indicates that white pine, shortleaf pine, pitch pine, and possibly Norway pine and Norway spruce, should be favored. Scotch and jack pine have fine records but both varieties are imported and are too much of the nature of the native scrub pine to be considered as having outstanding values for Kentucky forests. The red oak plot in the arboretum has fine survival and height growth. In April of this year about 18 acres of yellow poplar and black locust were planted at about 1,200 trees per acre, or approximately 7,000 locusts and 15,000 yellow poplars.

Syrup-Sorghum Seed for Poultry. A feeding trial was made with three pens of Barred Plymouth Rock pullets, all of which received the same kind of dry mash, hopper-fed. Grain was hopper-fed as follows: Pen 1, shelled yellow corn; Pen 2, equal parts of shelled yellow corn and sorghum seed; Pen 3, sorghum seed. Average egg production per pullet in the pen that received corn alone was 109 percent greater for the winter, and 14 percent greater for the year, than in the pen that received sorghum seed alone. Egg production in Pen 2 was intermediate. Hatchability was approximately the same for the three pens. Pen 3 consumed the smallest quantity of grain, in proportion to mash, and Pen 1 the largest. The inference is that the seed was not so palatable as corn, and that it is advisable to feed sorghum seed to laying pullets only if more suitable grain cannot be had.

Meetings. A larger number of meetings were held at the Substation this year than in any previous year. These included a 4-H leaders' conference; camp for farm women; 4-H camp for boys and girls; bible camp; camp for underprivileged girls and Regional Conference for Southern Mountain Workers and Kentucky Rural Church Council. The Robinson Harvest Festival, September 27 and 28, attracted entries of excellent quality.

As usual the attendance was good and much interest was manifested in the exhibits.

WESTERN KENTUCKY SUBSTATION

Fertilization of Dark Tobacco. This experiment is a six-year rotation with tobacco two years, wheat, mixed clover and grass for three years. Records are available on five crops grown (1934 crop not yet stripped) since the rotation was fully established.

On unlimed land the most profitable treatment was 500 pounds per acre with 3-10-10 fertilizer. The average yield of tobacco for five years was 1,188 pounds per acre, an increase of 317 pounds over that from unfertilized soil. Without further treatment except a top dressing of 100 pounds of nitrate of soda, wheat yielded 21.1 bushels per acre, an increase of 10.4 bushels per acre. Without any further treatment, hay following wheat yielded an average of 2,823 pounds per acre, an increase of 737 pounds over the untreated check. Hay occupies the land three years following wheat.

On limed land with 500 pounds of 3-10-10 fertilizer, the yield of tobacco was 1,219 pounds per acre, an increase of 327 pounds over that on the untreated check. Wheat following tobacco without further treatment except a top dressing of 100 pounds of nitrate of soda averaged 23.9 bushels per acre, an increase of 12.9 bushels over the untreated check. Hay following wheat without further treatment averaged 4,293 pounds per acre, an increase of 2,197 pounds over the untreated checks.

The best treatment in the test was on limed soil where 300 pounds of superphosphate and 10 tons of manure (6 tons for the last crop) were used for each tobacco crop. The average yield of tobacco was 1,260 pounds per acre, an increase of 349 pounds over the untreated checks. Wheat following without further treatment averaged 24.9 bushels, an increase of 13.8 bushels over the untreated checks. Hay following the wheat without any further treatment averaged 5,162 pounds per acre, an increase of 3,041 pounds over the untreated checks. The average annual acre values of the tobacco crops on the two last

treatments were \$123.82 and \$126.52, while the average value of the check plots nearest them was \$91.32.

Rate of Liming and Fineness of Limestone. The results thus far seem to indicate that the 40-50 mesh separate is most effective, and that limestone which passes a 10-mesh screen is satisfactory for small applications. An advantage of the small application is that limestone may be mixed with the fertilizer and drilled in when seeding grain. The small application is also advantageous where tobacco is to be grown, because there is no danger of injury to tobacco from the lime, if it is applied when the grain is sown in the rotation. One-third of a ton of 40-50 mesh limestone per acre, applied when grain was sown in a rotation of corn, wheat and mixed legumes, was practically as effective, over a nine-year period, as a two-ton application of 10-mesh and finer limestone applied at the beginning of the period.

Fertilizer Tests. The fertilizer and liming tests on the sandstone area were begun in 1929. Five crops each of corn, wheat and mixed hay have been harvested. The rates of fertilization are: Limestone, 2 tons per acre in 1928; superphosphate (P) 300 pounds per acre on corn and on wheat. Muriate of potash (K) 75 pounds per acre on corn and on wheat. Nitrate of soda (N) 45 pounds per acre on the hill for corn and 100 pounds top dressing for wheat. The average increases are given, together with the yields of the unfertilized and unlimed check plots.

Treatment	Corn, Bus.		Wheat, Bus.		Hay, Lbs.	
	Limed	Unlimed	Limed	Unlimed	Limed	Unlimed
P	17.6	10.3	8.2	6.4	1938	837
PK	16.5	9.9	8.3	5.5	1897	813
PN	17.7	12.4	13.7	12.2	2001	1133
PKN	20.7	11.7	12.8	12.2	2016	1222
Average yield of checks	-----	22.4	----	2.9	-----	1271

Legumes and Grasses in Rotation with Corn and Wheat.
The crop increases over the check plots for the most significant tests are given in the table. Crops before the rotation was fully established are not included.

Treat- ment	Third Year Crop	Corn, Bus. Ave. 6 yrs.	Wheat, Bus. Ave. 6 yrs.	Hay, Lbs. Ave. 7 yrs.
P	Lespedeza turned under	12.4	6.7	-----
P	Lespedeza for hay	6.9	5.6	1167
LP	Lespedeza for hay	16.8	8.5	2687
P	Cowpeas for hay	—1.0	2.5	2396
P	Soybeans for hay	—0.3	1.9	2232
LP	Sweet clover, 1st yr. for hay, 2nd yr. for seed	18.8	8.3	551
LP	Clover	19.2	10.4	1380
LP	Clover turned under	21.3	10.3	-----
LP	Timothy	6.3	3.0	457
LP	Clover and Timothy	16.3	6.8	1593
Average yield of untreated checks		36.7	6.9	1163

P = 300 lbs. superphosphate per acre on corn and on wheat.
L = 2 tons limestone applied in 1927.

Pasture Experiment. Despite the severe drouth of the first half of the season of 1934, fields treated with rock phosphate, limestone and superphosphate produced 172.5 pounds and 181.0 pounds of beef per acre, respectively, during the grazing season of 168 days. The untreated field produced 56.5 pounds of beef per acre. The total yields of beef per acre from each field, for the six seasons of grazing, are 808 pounds, 819 pounds and 287.5 pounds, respectively. The respective calculated total costs of this beef per pound are 3.3 cents, 3.2 cents and 8.4 cents.

The flora on the fields during 1934 was similar to that of previous recent years, tho apparently the slow trend toward better swards on the fertilized fields continues. Sheep fescue (*Festuca ovina*) which was included in the original seeding on all fields, was one of the dominant species on the rock phosphate

treated field but had practically disappeared from the other fields. Sour dock (*Rumex acetosella*) and field daisies (*Chrysanthemum leucanthemum pinnatifidum*) were likewise abundant in the flora of this field.

Steer Feeding. Twenty-two steers were used in a test to compare the rate of gain and economy of finishing cattle in the barn and on pasture during the summer of 1934. The steers had been fed an average ration of .48 pound cottonseed meal, 27.35 pounds corn silage and 11.1 pounds of No. 2 alfalfa hay from November 14, 1933, to April 11, 1934, on which date they were turned on pasture without grain until July 5, 1934, when this experiment was begun. It continued until September 6, 1934. On July 5, 1934, the steers were divided into two lots equally as to weight, quality and condition. One lot of 11 steers, averaging 1,048 pounds per head, was fed in the barn; the other lot of 11 steers, averaging 1,037 pounds, was kept on a pasture, which consisted mostly of orchard grass with some lespedeza and redtop. The steers of each lot were fed 12.44 pounds of corn-and-cob meal, and an average of .83 pound of cottonseed meal per head per day. The steers in the barn were fed daily 15.19 pounds of mixed No. 2 hay, but no hay was given those on pasture.

The average daily gain of the steers in the barn was 1.64 pounds per head and of those on pasture 2.04 pounds per head. The amount of feed per 100 pounds gain was 757 pounds of corn-and-cob meal; 50.6 pounds of cottonseed meal and 923 pounds of mixed hay for steers in the barn, and 610 pounds of corn-and-cob meal and 40.8 pounds of cottonseed meal for those on pasture. Valuing corn-and-cob meal at \$1.00 per hundredweight, cottonseed meal at \$1.60 per hundredweight, hay at \$12 per ton, and pasture at 5 cents per steer per day, the cost of 100 pounds of gain for the steers in the barn was \$15.70 and for the steers on pasture \$9.17.

At the close of the experiment, nine of the steers fed in the barn sold for \$7.25 per hundredweight and the remaining two for \$6.50 per hundredweight. Ten of the steers on pasture

sold for \$7.25 per hundredweight and the other one for \$6.50 per hundredweight.

Effect of Artificial Heat in a Laying House. Two similar houses, one provided with a "double-barrel" brooder stove in each pen, were used. Separate pens of 75 Barred Plymouth Rock pullets and of 75 White Leghorn pullets were kept in the heated and unheated houses. Whenever the temperature in the houses fell below freezing, sufficient fire was made to raise it slightly above freezing. High production and good hatches were obtained in both houses. Egg production was practically the same in both. Hatchability of the fertile eggs was somewhat better in the heated house. The advantage gained by heating was not sufficient to offset the cost of fuel and labor.

Apples. The plot receiving spring cultivation, sown to a summer cover crop of soybeans and a winter cover crop of rye and vetch, continued to make the best growth and produced almost twice as many apples as the plots seeded to sweet clover and to lespedeza, respectively. The Stayman variety produced four times as much fruit as any of the other varieties (Delicious, Winesap, and Transparent), but the loss due to splitting of the fruit before harvest amounted to 1/3 the crop. The other varieties did not split.

Meetings. The facilities of the Substation were utilized for a number of meetings, among them a two-day short course, a general horticultural field day, the annual field day, and the annual 4-H leaders' conference.

NEW PROJECTS

A chemical and insecticidal study of tobacco and tobacco by-products.

A study of new carriers and diluents for nicotine.

The development of strains of Burley tobacco of low nicotine content.

Control of wireworm injury to tobacco plants.

Cooperative marketing of tobacco in Kentucky.

Economic aspects of Federal control of production and marketing in Kentucky.

The paratyphoid group of bacteria.

Ictero-hematuria in sheep.

A comparison of Korean lespedeza hay, sericea lespedeza hay and alfalfa hay for ewes in lamb.

Feeding trials with low-grade lespedeza seed and screenings.

The relative values of dried Kentucky bluegrass blades 4 to 5 inches in height, wheat middlings and dried skim milk as sources of protein for growing chicks.

A comparison of bluegrass with cod liver oil and/or sunshine in the utilization of copper and iron, by chickens.

A study of sod webworm affecting forage crops.

Control of the rosy aphid of apple.

Prevention of injury to sweet corn by the corn earworm.

Chemical analyses of Kentucky bluegrass, orchard grass, redbud, timothy, Korean lespedeza, common lespedeza, Kobe lespedeza, lespedeza sericea, red clover, alfalfa, winter rye, winter wheat, at certain periods of growth.

Tests of phosphate fertilizers manufactured by the Tennessee Valley Authority.

Control of insects injurious to tobacco plants in the bed.

PUBLICATIONS

Bulletins:

- No. 346. The effect of confinement brooding on growth and egg production. G. Davis Buckner, J. Holmes Martin and W. M. Insko, Jr. January, 1934.
- No. 347. Factors for successful farm management in Todd, Christian and Warren counties. W. L. Rouse. April, 1934.
- No. 348. The relation of time of cutting to leafhopper injury to alfalfa. H. H. Jewett. April, 1934.
- No. 349. Studies of frenching of tobacco. P. E. Karraker and C. E. Bortner. April, 1934.

- No. 350. Rural organization contacts in three Kentucky communities. Fred Boyd, Merton Oyler and W. D. Nicholls. April, 1934.
- No. 351. Farm organization and family incomes in Knott county, Kentucky. W. D. Nicholls and W. L. Rouse. July, 1934.
- No. 352. An index of farm real-estate taxes in Kentucky. C. J. Bradley, H. B. Price and B. W. Allin. October, 1934.
- No. 353. The control of fruit pests. C. O. Eddy, W. D. Valleau and W. W. Magill. October, 1934.
- No. 354. Acidosis of pregnant ewes: So-called pregnancy disease of sheep. W. W. Dimock, D. J. Healy and F. E. Hull. November, 1934.
- No. 355. Farm taxes and local government in Crittenden and Livingston counties, Kentucky. T. B. Manny, B. W. Allin and C. J. Bradley. December, 1934.

Circulars:

- No. 41. Prevention and eradication of Bang's disease. W. W. Dimock. January, 1934.
- No. 42. Clover root curculio. H. H. Jewett. April, 1934.
- No. 43. Tests for phosphate, nitrate and soluble nitrogen in conducting tissue of tomato and lettuce plants as indicators of availability and yield. E. M. Emmert. September, 1934.

Regulatory Series Bulletins:

- No. 5. Commercial feeds and their use in Kentucky in 1933. J. D. Turner, H. D. Spears, W. G. Terrell and L. V. Amburgey. June, 1934.

Annual Reports:

- 45th Annual Report of the Station, Part II, Bulletins of 1932.
- 46th Annual Report of the Station, Part I, Report of the Director for 1933.
- 46th Annual Report of the Station, Part II, Bulletins of 1933.

Scientific Papers:

- An inexpensive lysimeter. P. E. Karraker. Jour. Amer. Soc. Agron. 26, 75.

- Transmission of angular leaf spot of tobacco by the southern tobacco worm. E. M. Johnson. *Phytopathology*, 24, 1381-2. 1934.
- Do tobacco plants recover from and develop immunity to ringspot? W. D. Valleau. Read before the American Phytopathological Society, Pittsburgh, 1934.
- Studies on the resistance of Ambalema tobacco to different viruses. W. D. Valleau. Read before the American Phytopathological Society, Pittsburgh, 1934.
- Apothecium production in *Sclerotinia trifoliorum* and *S. sclerotiorum*. Lawrence Henson. Read before the American Phytopathological Society, Pittsburgh, 1934.
- The growth of white leghorn chicks. G. Davis Buckner, W. M. Insko, Jr., and J. Holmes Martin. *Poultry Science*, 13, 110. 1934.
- The effect of accumulation of nest eggs on broodiness. G. Davis Buckner. Read at the 21st annual meeting of the Ky. Academy of Science. 1934.
- Kentucky marls as sources of calcium for laying hens. G. Davis Buckner, J. Holmes Martin and W. M. Insko, Jr. Read at the 22nd annual meeting of Poultry Science Association. 1934.
- The relationship between age, fecundity and hatchability. J. Holmes Martin and W. M. Insko, Jr. *Poultry Science*, 13, 188-190. 1934.
- The effect of cod liver oil on embryo mortality. W. M. Insko, Jr. *Poultry Science*, 13, 306. 1934.
- Incubation experiments with turkey eggs. J. Holmes Martin and W. M. Insko, Jr., *Poultry Science*, 13, 318-319. 1934.
- Hopper versus litter feeding of grain. J. Holmes Martin and W. M. Insko, Jr. *Poultry Science*, 13, 380. 1934.
- Is phosphorus a causative factor in the production of slipped tendon? W. M. Insko, Jr., D. F. Sowell and Malcolm Lyons. *Poultry Science*, 13, 370-375. 1934.
- Early-cut versus late-cut soybean hay as a feed for stocker cattle. E. S. Good and W. J. Harris. Read before the American Society of Animal Production. 1934.
- A rapid method for the determination of total nitrogen in soil. E. M. Emmert. *Soil Science*, 38, 139-142. 1934.
- Increasing the iodine content of corn and wheat by the use of certain fertilizer materials. J. S. McHargue and D. W. Young. Read at the 21st annual meeting of the Ky. Academy of Science. 1934.

- Tolerance of the albino rat to arsenic compounds. J. S. McHargue and W. R. Roy. Read at the 21st annual meeting of the Ky. Academy of Science. 1934.
- The necessity of copper for florification in corn plants. J. S. McHargue and R. K. Calfee. Read at the 21st annual meeting of the Ky. Academy of Science. 1934.
- A combustion method for the determination of iodine in plant material. J. S. McHargue, D. W. Young and R. K. Calfee. *Industrial and Engineering Chemistry, Analytical Edition*, 6, 318-19. 1934.
- Reports of the Associate Referee on the less common elements in soils and plants. J. S. McHargue, in collaboration with W. R. Roy, R. K. Calfee and D. W. Young. Presented at the Annual Meeting of the Association of Official Agricultural Chemists at Washington, D. C. October 29 to November 1, 1934.
- The role of some southern pine products in the control of *Aphis remicis* Linn. C. O. Eddy. *Journal of Economic Entomology*, 27, 398. 1934.
- Soybean oil meal (flour) emulsifies mineral oils. C. O. Eddy. *Transactions of the Kentucky State Horticultural Society for 1933*, 139-141.
- The 1934 spray program. C. O. Eddy. *Transactions of the Kentucky State Horticultural Society for 1933*, 114-129.
- The green June beetle in lawns. W. A. Price. *Journal of Economic Entomology*, 27, 69-72. 1934.
- The viability of dodder seed after feeding. W. A. Price and E. S. Good. Read at the 21st annual meeting of the Ky. Academy of Science. 1934.
- Spray program for fruit insect control in 1935. C. O. Eddy. *Transactions of Kentucky State Horticultural Society for 1934*.
- Grape leafhopper control. C. O. Eddy. *Transactions of Kentucky State Horticultural Society for 1934*.
- Thrips injury to peach nursery stock. C. O. Eddy and Louis Hillenmeyer. *Transactions of Kentucky State Horticultural Society for 1934*.
- Tests for nutrients in conducting tissue as indicators of the nutritional status of horticultural crops. E. M. Emmert. Presented at the annual meeting of the American Society for Horticultural Science. 1934.

Artificial insemination. W. W. Dimock. *North American Veterinarian*, 15, 22-28, May, 1934.

Characters of hemolytic streptococci isolated from pathologic conditions in fowls. Philip R. Edwards. *Jour. Comp. Path. and Therap.* 47, 152-157, June, 1934.

The differentiation of hemolytic streptococci of human and animal origin. Philip R. Edwards. *Jour. Bact.* 27, 527-534, 1934.

A note on the hydrolysis of sodium hippurate by the hemolytic streptococci. Philip R. Edwards and Robert Broh-Kahn. *Jour. Bact.* 27, 535, 1934.

FINANCIAL STATEMENT

In Account with the United States Appropriations, 1934

	Hatch Fund	Adams Fund	Purnell Fund
Receipts:			
From the Treasury of the United States, as per appropriations for fiscal year ended June 30, 1934, under acts of Congress approved March 2, 1887 (Hatch Fund), March 16, 1906 (Adams Fund), and February 24, 1925 (Purnell Fund)	\$15,000.00	\$15,000.00	\$60,000.00
Expenditures:			
By personal services	\$14,753.40	\$14,873.22	\$55,750.49
Supplies and materials		101.58	1,113.96
Communication service			60.00
Travel expenses	43.21		1,118.60
Transportation of things			12.65
Publications	198.39		889.02
Heat, light, water and power		25.20	28.80
Equipment			1,026.48
Total	\$15,000.00	\$15,000.00	\$60,000.00

Interest earned on above during the period indicated—
None.

We, the undersigned, duly appointed auditors of the expenditures from Federal appropriations reported herein, do

hereby certify that we have examined the books and accounts of the Kentucky Agricultural Experiment Station for the fiscal year-ended June 30, 1934; that we have found the same well kept and classified as above; and that the balances, receipts, and disbursements are as follows:

	Hatch Fund Act of Congress March 2, 1887	Adams Fund Act of Congress Mar. 16, 1906	Purnell Fund Act of Congress Feb. 24, 1925	Totals All Funds
Receipts for the year from the Treasurer of the United States	\$15,000.00	\$15,000.00	\$60,000.00	\$90,000.00
Disbursements for the year	15,000.00	15,000.00	60,000.00	90,000.00
Unexpended balance June 30, 1934	None	None	None	None

Proper vouchers for all of the above disbursements are on file and have been examined by us and found correct.

And we further certify that the expenditures have been solely for the purposes set forth in the acts of Congress approved March 2, 1887, March 16, 1906, and February 24, 1925, and in accordance with the terms of said acts, respectively.

Signed:

THOMAS COOPER,

Director of the Experiment Station

D. H. PEAK, Business Agent,

Financial Officer of the Institution

D. H. PEAK,

Secretary of the Governing Board

Attest:

JANE J. NICHOLS,

Custodian of the Seal.

